2021 REGION B REGIONAL WATER PLAN

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Prepared for

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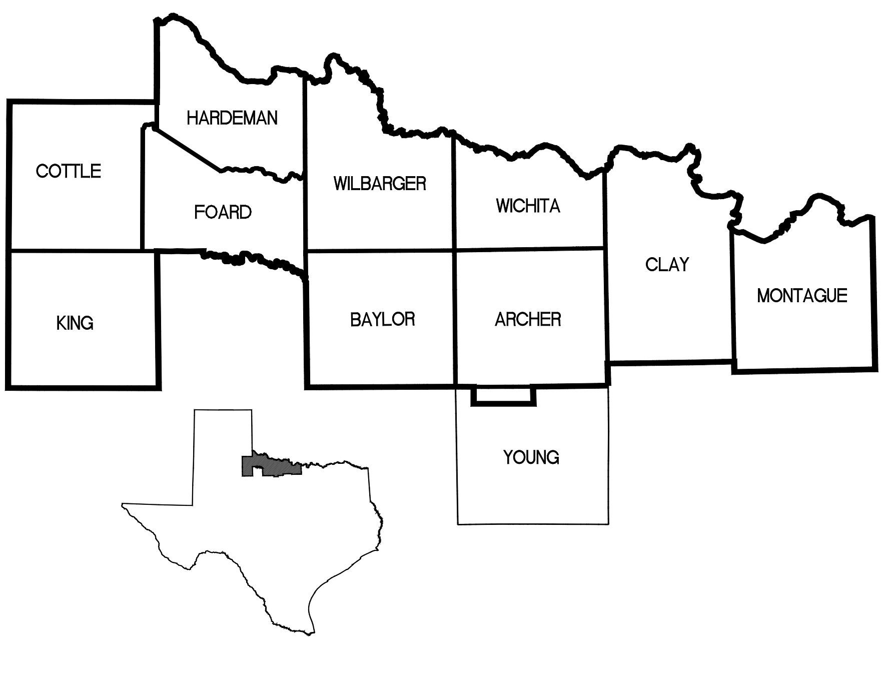
October 2020



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Red River Authority of Texas

TABLE OF CONTENTS

Partial List of Acronyms

Executive Summary

ES.1 Introduction ES-1

ES.2 Planning Area Description ES-3

ES.3 Population and Water Demand Projections..ES-5

ES.4 Water Availability and Existing Water Supplies ES-7

ES.5 Identification of Water Needs ES-9

ES.6 Water Management Strategies..ES-14

Water Conservation ES-14

Major Water Providers..ES-15

County Summaries ES-17

Archer County..ES-17

Baylor County..ES-18

Clay County ES-18

Foard County..ES-18

Hardeman County ES-19

Montague County..ES-19

Wichita County ES-20

Wilbarger County..ES-21

Young County..ES-21

ES.7 Unique Stream Segments and Reservoir Sites and Other RecommendationsES-22

Chapter 1 Planning Area Description

1.1 Region B Overview.. 1-1

1.2 Population and Demographic Data 1-1

1.3 Water Use Demand Centers.. 1-5

1.4 Water Supply and Use.. 1-6

1.5 Climate Data 1-20

1.6 Economic Aspects of Region B 1-21

1.7 Land Use 1-22
1.8 Navigable Waterways 1-23
1.9 Ecology and Wildlife 1-23
1.10 Summary of Existing Local or Regional Water Plans 1-25
1.11 Summary of Recommendations 1-28
1.12 Identification of Known Threats to Agriculture or Natural Resources 1-28
1.13 Water Providers in Region B 1-29
1.14 Major Water Providers 1-31
1.15 Water Loss Audits 1-33
List of References 1-34

Chapter 2 Population and Water Demand Projections
2.1 Region B Overview 2-1
2.2 Population Growth 2-2
2.3 Water Uses 2-3
2.3.1 Total Region B Use 2-3
2.3.2 Municipal Water Use 2-6
2.3.3 Manufacturing Water Use 2-6
2.3.4 Steam-Electric Power Generation Water Use 2-8
2.3.5 Mining Water Use 2-8
2.3.6 Agricultural Irrigation Water Use 2-8
2.3.7 Livestock Watering Use 2-10
2.3.8 Major Water Providers 2-10
2.3.9 Region B Water Plan 2-12
List of References 2-13

Chapter 3 Evaluation of Current Water Supplies
3.1 Existing Surface Water Supply 3-1
3.1.1 Existing Water Supply Reservoirs 3-2
Greenbelt Lake 3-2
Lakes Kemp and Diversion 3-3

Little Wichita River System 3-5
Lake Kickapoo 3-5
Lake Arrowhead 3-5
Lakes Olney and Cooper 3-6
Lake Nocona 3-6
Amon G. Carter 3-6
Miller's Creek Reservoir 3-7
Santa Rosa Lake 3-7
3.1.2 Other Lakes and Reservoirs in the Region 3-7
Lake Electra 3-8
North Fork Buffalo Creek Reservoir 3-8
Lake Iowa Park 3-8
Lake Wichita 3-9
Lake Pauline 3-9
Bowie Lake 3-9
3.1.3 Reservoir and Run-of-River Yields 3-9
3.2 Groundwater Supplies 3-16
3.2.1 General Description 3-16
Seymour Aquifer 3-17
Blaine Aquifer 3-18
Trinity Aquifer 3-19
Cross Timbers Aquifer 3-20
3.2.2 Modeled Available Groundwater 3-20
3.2.3 Springs in Region B 3-22
3.2.4 Groundwater Conservation Districts 3-22
3.2.5 Priority Groundwater Management Areas 3-23
3.3 Wastewater Reuse Supplies 3-24
3.4 Inter-Basin Transfers and Inter-Region Transfers 3-25
3.5 Allocation of Existing Supplies 3-25
3.5.1 Water User Groups 3-25
3.5.2 Major Water Providers 3-26

3.6 Summary of Currently Available Supplies 3-28
List of References 3-30

Chapter 4 Identification of Water Needs

4.1 Introduction 4-1
4.2 First Tier Water Needs Analysis 4-2
4.2.1 Identified Shortages for Water Use Groups 4-3
Irrigation 4-5
Municipal 4-5
Manufacturing 4-6
Mining 4-6
Steam Electric Power 4-7
Livestock 4-7
4.2.2 Comparison of Supply and Demand for Major Water Providers 4-8
4.2.3 Summary of First Tier Water Needs 4-9
4.3 Evaluation of Reliable Supply 4-9
4.4 Effect of Water Quality on Supply 4-11
4.4.1 Municipal Water Systems with Existing or Potential Quality Concerns 4-11
Nitrate Concerns 4-12
4.4.2 Salinity Concerns for Lake Kemp and Diversion Lake 4-13
4.5 Summary of Needs 4-15
4.6 Second Tier Water Needs Analysis 4-16
List of References 4-17

Chapter 5 Water Management Strategies

5.1 Evaluation of Potentially Feasible Strategies 5-2
5.1.1 Identification of Potentially Feasible Strategies 5-2
Potentially Feasible Strategies not appropriate for Region B 5-3
Potentially Feasible Water Management Strategies for Region B 5-5
5.1.2 Water Conservation 5-5

5.1.3 Wastewater Reuse 5-6
5.1.4 Expanded Use of Existing Supplies 5-6
System Operation 5-6
Conjunctive Use of Groundwater and Surface Water 5-7
Water Quality Improvements 5-7
Voluntary Redistribution 5-7
5.1.5 New Supply Development 5-8
Surface Water Development 5-8
Groundwater Development 5-8
Brush Control 5-10
Desalination 5-11
5.1.6 Summary of Potentially Feasible Strategies 5-11
5.2 Strategy Development and Evaluation 5-11
5.2.1 Strategy Evaluation Criteria 5-12
5.3 Water Conservation 5-14
5.3.1 WUG and WWP Conservation Requirements 5-15
Municipal/Public Water Supply Conservation Plan Requirements 5-17
Industrial or Mining Water Conservation Plan Requirements 5-18
Agriculture Water Conservation Plan Requirements 5-18
Water Conservation Plans for Wholesale Water Providers 5-19
5.3.2 Water Conservation Included in the Demand Projections 5-20
Municipal Demand 5-20
Manufacturing Demands 5-20
Mining Demands 5-21
Livestock Demands 5-21
Irrigation Demands 5-21
Steam Electric Demands 5-21
5.3.3 Water Conservation Strategies for Region B 5-22
Municipal Conservation 5-24
Water Quantity, Reliability and Cost 5-25
Environmental Factors 5-26

Impacts on Water Resources and Other Management Strategies 5-26
Impacts on Agriculture and Natural Resources 5-26
Other Relevant Factors.. 5-26
Agriculture Conservation 5-26
Mining Conservation.. 5-30
Steam Electric Power Conservation 5-32
5.3.4 Water Conservation Summary 5-33
5.4 Major Water Providers 5-33
5.4.1 Wichita Falls 5-34
Water Conservation/Efficiency 5-35
Water Quantity, Reliability and Cost 5-35
Environmental Factors 5-36
Impacts on Water Resources and other Management 5-36
Impacts on Agriculture and Natural Resources 5-36
Other Relevant Factors.. 5-36
Local Seymour Aquifer... 5-37
Water Quantity, Reliability and Cost 5-37
Environmental Factors 5-38
Impacts on Water Resources and other Management Strategies 5-38
Impacts on Agriculture and Natural Resources 5-38
Other Relevant Factors.. 5-39
Summary 5-39
Wichita River Supply... 5-40
Water Quantity, Reliability and Cost 5-40
Environmental Factors 5-41
Impacts on Water Resources and other Management Strategies 5-41
Impacts on Agriculture and Natural Resources 5-42
Other Relevant Factors.. 5-42
Summary 5-42
Lake Ringgold... 5-42
Water Quantity, Reliability and Cost 5-43

Environmental Factors 5-44
Impacts on Water Resources and other Water Management Strategies 5-45
Impacts on Agriculture and Natural Resources 5-45
Other Relevant Factors 5-45
Summary of Recommended Strategies for Wichita Falls 5-45
5.4.2 Wichita County Water Improvement District No. 2 5-47
Water Quantity, Reliability and Cost 5-48
Environmental Factors 5-48
Impacts on Water Resources and other Management Strategies 5-49
Impacts on Agriculture and Natural Resources 5-49
Other Relevant Factors 5-49
5.5 County Summaries 5-50
5.5.1 Archer County 5-51
Archer City 5-51
Summary of Recommended Strategies for Archer City 5-52
Archer County MUD No. 1 5-53
Summary of Recommended Strategies for Archer County MUD 5-53
Archer County-Other 5-54
Summary of Recommended Strategies for Archer County-Other 5-54
Holliday 5-55
Summary of Recommended Strategies for Holliday 5-55
Lakeside City 5-56
Summary of Recommended Strategies for Lakeside City 5-56
Scotland 5-57
Recommended Strategies for Scotland 5-57
Windthorst WSC 5-58
Summary of Recommended Strategies for Windthorst WSC 5-58
Irrigation – Archer County 5-59
Summary of Recommended Strategies for Irrigation–Archer County 5-59
Mining – Archer County 5-60
Summary of Recommended Strategies for Mining–Archer County 5-60

Archer County Summary 5-61
5.5.2 Baylor County 5-62
Baylor County SUD 5-62
Baylor County Summary 5-63
5.5.3 Clay County 5-63
Clay County - Other 5-64
Summary of Recommended Strategies for Clay County - Other......... 5-64
Red River Authority 5-65
Windthorst WSC 5-66
Clay County Summary 5-66
5.5.4 Cottle County 5-67
Cottle County Summary 5-67
5.5.5 Foard County 5-68
Crowell 5-68
Summary of Recommended Strategies for Crowell 5-69
Foard County Summary 5-69
5.5.6 Hardeman County 5-70
Quanah 5-70
Summary of Recommended Strategies for Quanah 5-71
Manufacturing – Hardeman County 5-72
Summary of Recommended Strategies for Manufacturing-Hardeman 5-72
Red River Authority 5-72
Hardeman County Summary 5-73
5.5.7 King County 5-74
King County Summary 5-74
5.5.8 Montague County 5-75
Bowie 5-75
Montague County - Other 5-76
Nocona Hills WSC 5-77
Mining - Montague County 5-78
Summary of Recommended Strategies for Mining – Montague Co.... 5-78

Montague County Summary 5-78
5.5.9 Wichita County 5-79
Electra 5-80
Summary of Recommended Strategies for Electra 5-80
Harrold WSC 5-81
Iowa Park 5-81
Summary of Recommended Strategies for Iowa Park 5-81
Wichita Falls 5-82
Sheppard Air Force Base 5-82
Irrigation – Wichita County 5-83
Summary of Recommended Strategies for Irrigation – Wichita Co. 5-83
Manufacturing – Wichita County 5-84
Summary of Recommended Strategies for Manuf.–Wichita County. 5-84
Steam Electric – Wichita County 5-85
Summary of Recommended Strategies for Steam Elect. Wichita Co. 5-85
Wichita County Summary 5-85
5.5.10 Wilbarger County 5-86
Harrold WSC 5-87
Red River Authority 5-87
Vernon 5-88
Summary of Recommended Strategies for Vernon 5-88
Manufacturing-Wilbarger County 5-89
Summary of Recommended Strategies for Manuf. Wilbarger County 5-89
Steam Electric-Wilbarger County 5-90
Summary of Recommended Strategies for Steam Electric-Wilbarger 5-90
Wilbarger County Summary 5-90
5.5.11 Young County 5-92
Young County - Other 5-92
Summary of Recommended Strategies for Young County - Other 5-92
Olney 5-93
Young County Summary 5-94

5.5.12 Regional Strategies 5-94
Red River Chloride Control Project 5-94
Background 5-95
Description of Chloride Control Project 5-95
Water Quantity, Reliability and Cost 5-97
Environmental Factors 5-97
Impacts on Water Resources and Other Management Strategies 5-99
Impacts on Agriculture and Natural Resources 5-99
Other Relevant Factors 5-99
List of References 5-101
Attachment 5-1
Attachment 5-2
Attachment 5-3

Chapter 6 Impacts of the Regional Water Plan
6.1 Requirements 6-1
6.2 Socioeconomic Impacts of not Meeting Identified Water Needs 6-2
6.3 Impacts of the Regional Water Plan on Agricultural Resources 6-3
6.4 Impacts of the Regional Water Plan on Other Water Resources 6-3
6.4.1 Water Conservation 6-4
6.4.2 Water Reuse 6-5
6.4.3 Voluntary Transfers 6-5
6.4.4 Development of New and/or Expanded Surface Water Supplies 6-5
Lake Ringgold 6-5
6.4.5 New and/or Expanded Use of Groundwater 6-6
6.4.6 Brush Control 6-6
6.4.7 Conjunctive Use 6-6
6.4.8 Advanced Treatment 6-6
6.4.9 Chloride Control Project 6-7
6.5 Threats to Agricultural and Natural Resources 6-7

6.5.1 Agricultural Resources 6-7
6.5.2 Natural Resources 6-7
6.6 Impacts of Moving Water from Agricultural and Rural Areas 6-8
6.7 Impacts of Recommended WMS on Key Water Quality Parameters 6-8
6.7.1 Water Conservation 6-9
6.7.2 Reuse 6-9
6.7.3 Voluntary Transfers 6-10
6.7.4 New and/or Expanded Use of Groundwater Resources 6-10
6.7.5 Development of New Surface Water Supplies 6-10
6.7.6 Brush Control 6-11
6.7.7 Conjunction Use 6-11
6.7.8 Advanced Treatment 6-11
6.7.9 Precipitation Enhancements 6-11
6.7.10 Chloride Control Project 6-12
6.8 Impacts on Navigation, Existing Water Contracts, and Option Agreements 6-12
6.9 Summary of Identified Water Needs that Remain Unmet 6-12
6.10 Consistency with Protection of State's Water, Agricultural, and Nat. Res. 6-13
6.10.1 Water Resources 6-13
6.10.2 Agricultural Resources 6-15
6.10.3 Natural Resources 6-15
Threatened/Endangered Species 6-15
Parks and Public Lands 6-15
Energy/Mineral Reserves 6-15
6.11 Consistency with State Water Planning Guidelines 6-16

Chapter 7 Drought Response Information, Activities and Recommendations

7.1 Introduction 7-1
7.2 Droughts of Record 7-2
7.2.1 Current Droughts of Record 7-4
7.2.2 Recent Droughts in the Region 7-5
7.3 Summary of Current Drought Triggers 7-10

7.3.1 Lake Kickapoo and Lake Arrowhead 7-10
7.3.2 Lake Kemp 7-10
7.3.3 Petrolia City Lake 7-11
7.3.4 Lake Olney and Cooper 7-11
7.3.5 North Fork Buffalo Creek Lake 7-11
7.3.6 Lake Electra 7-11
7.3.7 Lake Amon G. Carter 7-12
7.3.8 Greenbelt Reservoir 7-12
7.3.9 Groundwater Sources 7-12
Gateway Groundwater Conservation District 7-12
Rolling Plains Groundwater Conservation District 7-13
Upper Trinity Groundwater Conservation District 7-13
7.4 Current Drought Preparations and Response 7-13
7.4.1 Entities Required to Have DCP's 7-14
7.4.2 Water Use Reduction Targets 7-15
7.4.3 Unnecessary or Counterproductive Variation In Drought Strategies ... 7-18
7.5 Existing and Potential Emergency Interconnects 7-19
7.5.1 Existing Emergency Interconnects 7-19
7.5.2 Potential Emergency Interconnects 7-21
7.6 Emergency Responses to Local Drought or Loss of Municipal Supply 7-21
7.6.1 Emergency Response to Local Drought Conditions 7-21
7.6.2 Voluntary Transfer of Irrigation Rights 7-25
7.6.3 Brackish Groundwater 7-25
7.6.4 Drill Additional Local Groundwater Wells and Trucking Water 7-25
7.7 Region-Specific Drought Response Recommendations and Model DCP's 7-25
7.7.1 Drought Trigger Conditions for Groundwater Supplies 7-26
7.7.2 Model Drought Contingency Plans 7-27
7.8 Drought Management Water Management Strategies 7-28
7.9 Other Drought Recommendations 7-28
List of References 7-30

Chapter 8 Unique Stream Segments and Reservoir Sites and Other Recommendations

8.1 Introduction 8-1
8.2 Discussion of Regional Issues........ 8-1
8.2.1 Chloride Control Project 8-1
8.2.2 Land Stewardship........ 8-2
8.2.3 Recharge Enhancement........ 8-2
8.2.4 Sediment Control Structures 8-3
8.3 Designation of Unique Stream Segments and Reservoir Sites 8-3
8.3.1 Unique Stream Segments 8-3
8.3.2 Reservoir Sites 8-4
8.4 Discussion of Regulatory and Legislative Actions 8-5
8.4.1 Regulatory Review of Nitrate MCL 8-5
8.4.2 Funding for Comprehensive Studies........ 8-5
8.4.3 Conservation........ 8-6
8.5 Summary of Regional Recommendations........ 8-6

Chapter 9 Reporting of Financing Mechanisms for Water Management Strategies

Introduction........ 9-1
Identification of Needs........ 9-1
Recommended Water Management Strategies 9-3
Infrastructure Financing Surveys for Preferred Water Management Strategies........ 9-4
Financing Policy Recommendations........ 9-5

Chapter 10 Adoption of Plan and Public Participation

10.1 Introduction........ 10-1
10.2 Regional Water Planning Group 10-1
10.3 Planning Group Meetings 10-3
10.4 Media Communications 10-5
10.5 Internet Web Page........ 10-5
10.6 Regional Water Plan Implementation Issues........ 10-5
10.7 Plan Adoption Process........ 10-7

10.7.1 Initially Prepared Plan Adoption 10-7
10.7.2 Public Hearing 10-7
10.7.3 Response to Comments 10-8
10.7.4 Final Regional Water Plan Adoption 10-8
10.8 Conclusion 10-8

Chapter 11 Implementation and Comparison to Previous Regional Water Plan

11.1 Introduction 11-1
11.2 Differences between Previous and Current Regional Water Plan 11-1
11.2.1 Removed and New Water User Groups 11-1
11.2.2 Population Projections 11-2
11.2.3 Water Demand Projections 11-2
11.2.4 Drought of Record and Hydrologic Modeling Assumptions 11-4
Hydrologic Modeling Assumptions 11-4
11.2.5 Groundwater and Surface Water Availability 11-5
11.2.6 Existing Water Supplies of Water Users 11-7
New Existing Sources of Supply for Water Users 11-8
Reduced Existing Surface Water Supplies 11-8
11.2.7 Identified Water Needs 11-8
11.2.8 Recommended and Alternate Water Management Strategies 11-10
New Water Management Strategies 11-10
Municipal Conservation 11-11
No Longer Considered Water Management Strategies 11-11
Cooperation Between WUGs to Achieve Economies of Scale 11-12
11.3 Implementation of Previously Recommended Management Strategies 11-12
11.3.1 City of Wichita Falls 11-13
11.4 Conclusion 11-13

Appendix A – Water Availability Modeling

Appendix B – WUG Summary Tables

Appendix C – Cost Estimates

Appendix D – Strategy Evaluation and Quantified Environmental Impact Matrix

Appendix E – Economic Impact Analysis

Appendix F – Consistency Matrix

Appendix G – DB22 Reports

Appendix H – Implementation Survey for 2016 Regional Plan

Appendix I – Comments Received on IPP and Responses

Appendix J – Infrastructure Financing Report Survey Results

REGION B REGIONAL WATER PLAN
Partial List of Acronyms

Acronym	Name	Meaning
DFC	Desired Future Condition	Criteria for which is used to define the amount of available groundwater from an aquifer.
GAM	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.
GCD	Groundwater Conservation District	Generic term for all or individual state recognized Districts that oversee the groundwater resources within a specified political boundary.
GMA	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.
MAG	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.
MGD	Million Gallons per Day	Measurement of rate of use. Typically used when sizing infrastructure.
MWP	Major Water Provider	A Water User Group or a Wholesale Water Provider of particular significance or importance to the region's water supply as determined by the Regional Water Planning Group. Region B has identified two MWPs; Wichita Falls and WCWID #2
gpm	Gallons per minute	Measurement of rate. Typically used to describe a diversion rate or capacity of water wells.
RWPG	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
SB1	Senate Bill One	Legislation passed by the 75th Texas Legislature that is the basis for the current regional water planning process.
SB2	Senate Bill 2	Legislation passed by the 77th Texas Legislature that built on policies created in SB1.
TCEQ	Texas Commission on Environmental Quality	Texas Agency charged with oversight of Texas surface water rights and WAM program.

REGION B REGIONAL WATER PLAN
Partial List of Acronyms

Acronym	Name	Meaning
TWDB	Texas Water Development Board	Texas Agency charged with oversight of regional water plan development and oversight of GCDs
WAM	Water Availability Model	Computer model of a river watershed that evaluates surface water availability based on Texas water rights.
WCWID #2	Wichita County Water Improvement District #2	Entity responsible for operating the Lake Kemp and Diversion system for irrigation use.
WMS	Water Management Strategy	Strategies available to RWPG to meet water needs identified in the regional water plan.
WUG	Water User Group	A group that uses water. Six major types of WUGs: municipal, manufacturing, mining, steam electric power, irrigation and livestock.
WWP	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

2021 FINAL PLAN

REGION B

OCTOBER 2020

EXECUTIVE SUMMARY

2021 FINAL PLAN
REGION B

Chapter Outline

Section ES.1 – Introduction
Section ES.2 - Planning Area Description
Section ES.3 - Population and Water Demand Projections
Section ES.4 - Water Availability and Existing Water Supplies
Section ES.5 - Identification of Water Needs
Section ES.6 - Water Management Strategies
Section ES.7 - Unique Stream Segments and Reservoir Site and Other Recommendations

Related Appendices

Appendix G – DB22 Reports

ES.1 Introduction

Senate Bill 1 of the 75th Texas Legislature was passed in 1997 to set the process of developing a comprehensive state water plan. To accomplish this task, the state was divided into 16 regional water planning groups. This report describes Region B as designated by Senate Bill 1. Region B is comprised of ten entire counties and a portion of one county in north central Texas. Specifically, those counties are Archer, Baylor, Clay, Cottle, Foard, Hardeman, King, Montague, Wichita, Wilbarger, and the City of Olney in Young County. Since the initiation of this process the Region B Regional Water Planning Group (RWPG) has developed four regional water plans and this plan, 2021 Region B Plan is the fifth regional water plan, which is an update of the 2016 Regional Water Plan for Region B.

This Plan was developed in accordance with the Planning Guidelines set forth in 31 Texas Administrative Code 357.7 and all applicable rules. As required by rule, the plan is organized into eleven chapters as follows:

1. Planning Area Description
2. Population and Water Demand Projections
3. Water Availability and Existing Water Supplies

4. Identification of Water Needs
5. Water Management Strategies and Water Management Strategy Projects
6. Impacts of the Regional Water Plan
7. Drought Response Information, Activities, and Recommendations
8. Unique Stream Segments and Reservoir Sites and Other Recommendations
9. Reporting of Financing Mechanisms for Water Management Strategies
10. Adoption of Plan and Public Participation
11. Implementation and Comparison to the Previous Regional Water Plan

Table ES-1 below list the 19 members of the Region B RWPG, their organization, the interest they represent, and their counties.

Table ES-1

Regional Water Planning Group - Area B			
Name	**Organization**	**Interest**	**County**
Heath Ownbey	W.T. Waggoner Estate	Agricultural	Wilbarger
Wilson Scaling	Scaling Ranch	Agricultural	Clay
Judge Mark Christopher	Foard County	Counties	Foard
Judge Randall C. Jackson	Archer County	Counties	Archer
Steve Lewis	American Electric Power	Electric Generating Utility	Wilbarger
J. K. (Rooter) Brite	J. A. Ranch	Environmental	Montague/All
Jerry L. Payne	Natural Resources Conservation Service (Retired)	Environmental	Clay
Jimmy Banks	Public	General Public	Wichita
Carrie Dodson	Gateway Groundwater Conservation District	Groundwater Management Area 6	Hardeman
Tracy Mesler	Upper Trinity Groundwater Conservation District	Groundwater Management Area 8	Montague
Tamela Armstrong	Alliance Power Company	Industries	Wichita
Darell Kennon	City of Vernon	Municipalities	Wilbarger
Russell Schreiber	City of Wichita Falls	Municipalities	Wichita
Mayor Pro Tem Gayle Simpson	City of Crowell	Municipalities	Foard
Randy Whiteman	Red River Authority of Texas	River Authorities	All
Dean Myers	Bowie Industries, Inc.	Small Business	Montague
Kyle Miller	Wichita County Water Improvement District No. 2	Water Districts	Wichita
Mike McGuire	Rolling Plains Groundwater Conservation District	Water Districts	Baylor
Tommy Holub	Baylor County Special Utility District	Water Utilities	Baylor

ES.2 Planning Area Description

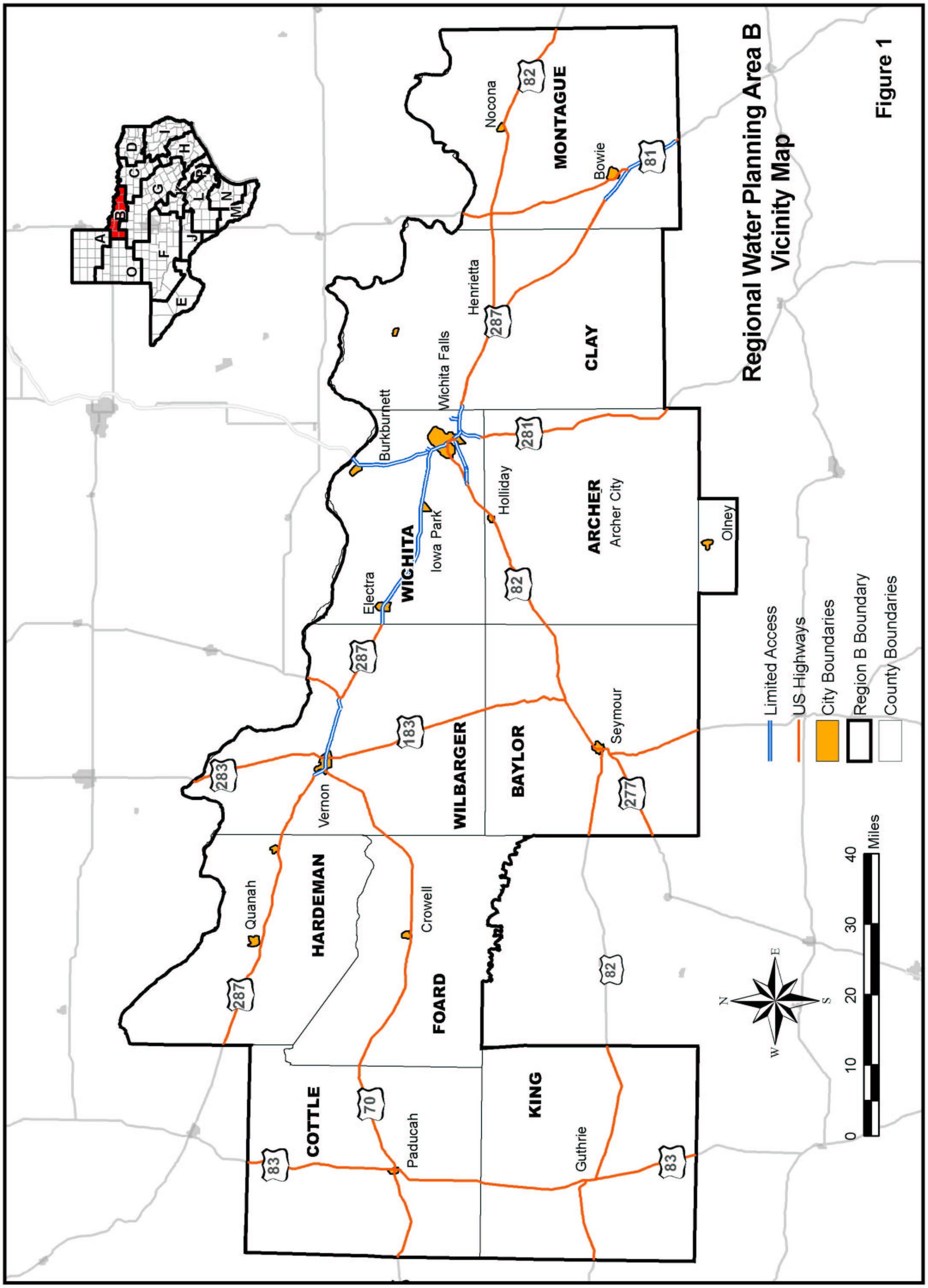
Region B lies mainly in the Red River Basin, however, southern portions of Archer, Clay, and Montague Counties lie in the Trinity River Basin, and southern portions of Archer, Baylor, and King Counties lie in the Brazos River Basin. Shown in Figure 1, is the designated Region B Planning Area and the cities, towns, and counties that are included in Region B.

Based on the latest 2018 estimates the total population of the region was reported to be 197,701, with the largest population center, the City of Wichita Falls, being 104,576 or 53 percent of the total. The second largest city was Burkburnett with a population of 11,250.

In general, most of the population is concentrated in eastern portions of the region with over one-half located in and around Wichita Falls. The 2018 estimated population density of the region ranged from a high of 210 persons per square mile (Wichita County) to a low of less than one person per square mile (King County), and the regional population is forecast to increase by approximately 11 percent over the study period.

The City of Wichita Falls is the largest water demand center in the region, with other water notable demand centers being Vernon, Burburnett, Iowa Park, Bowie, Henrietta, Nocona, Seymour, Electra, Quanah and Archer City.

While the population of Region B is only expected to reach near 229,000 by 2070, the Dallas-Fort Worth Metroplex, located just east of the region, is expected to top 9 million.


Regional Water Planning Area B
Vicinity Map
Figure 1
Limited Access
US Highways
City Boundaries
Region B Boundary
County Boundaries
0
10
20
30
40
Miles
MONTAGUE
CLAY
ARCHER
WICHITA
WILBARGER
BAYLOR
HARDEMAN
FOARD
COTTLE
KING
Nocona
Bowie
Henrietta
Wichita Falls
Burkburnett
Holliday
Archer City
Olney
Iowa Park
Electra
Seymour
Vernon
Quanah
Crowell
Paducah
Guthrie
82
81
287
281
283
183
277
70
83

ES.3 Population and Water Demand Projections

Previous regional and state water plans were aligned with political boundaries, such as city limits, rather than utility service areas. In accordance with the Texas Water Development Board (TWDB) rule changes, Water User Group (WUG) planning in this plan is defined as utility-based and the population projections and associated water demand projections are for the utility service area boundaries as opposed to the political boundaries.

Municipal WUGs in the 2021 Plan are defined as:

- 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 above 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 (RWPG);
- Municipal and domestic water use, referred to as County-Other, not included in the above;

Region B has 38 WUG's throughout its eleven county area, and TWDB prepared the population projections by decade for all municipal WUG's using projection trends based on the population projections in the 2017 State Water Plan (SWP) as assembled by utility service area.

Table ES-2 shows the population projections and associated water demands by decade for each WUG by county and rural areas outside of a WUG service area as "County-Other".

In addition, water demands for Region B have been divided into several categories for analysis purposes. The various uses analyzed include water for municipal use (MUN), industrial or manufacturing (MFG), power plant cooling (PWR), mining (MIN), agricultural irrigation (IRR), and livestock watering (STK). Table ES-3 shows the amounts of water predicted to be required for these categories through the year 2070. The water demand is shown in acre-feet per year (Ac-Ft/Yr.) units with one acre-foot being equivalent to 325,850 gallons of water.

Table ES-2
Population and Water Demand Projection

WUG Name	County	Population						Municipal Demands					
		2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
Archer City	Archer	1,727	1,727	1,727	1,727	1,727	1,727	263	255	248	244	244	244
Archer County MUD 1	Archer	806	807	817	817	817	817	147	144	143	141	141	141
Baylor SUD	Archer	152	154	154	157	158	159	33	33	33	33	33	33
County-Other, Archer	Archer	764	661	630	627	626	625	133	114	108	107	106	106
Holliday	Archer	1,606	1,832	1,920	1,920	1,920	1,920	231	255	262	259	258	258
Lakeside City	Archer	937	971	971	971	971	971	125	125	121	120	119	119
Scotland	Archer	552	698	698	698	698	698	194	242	240	239	239	239
Wichita Valley WSC	Archer	1,877	1,962	1,998	1,998	1,998	1,998	221	222	220	216	215	215
Windthorst WSC	Archer	988	1,033	1,045	1,045	1,045	1,045	294	303	303	301	301	301
Archer County Totals		**9,409**	**9,845**	**9,960**	**9,960**	**9,960**	**9,960**	**1,641**	**1,693**	**1,678**	**1,660**	**1,656**	**1,656**
Baylor SUD	Baylor	893	910	917	923	928	933	197	196	194	195	195	196
County-Other, Baylor	Baylor	121	104	97	91	86	81	16	13	12	11	11	10
Seymour	Baylor	2,712	2,712	2,712	2,712	2,712	2,712	490	476	465	464	463	463
Baylor County Totals		**3,726**	**3,726**	**3,726**	**3,726**	**3,726**	**3,726**	**703**	**685**	**671**	**670**	**669**	**669**
County-Other, Clay	Clay	3,672	3,838	3,838	3,838	3,838	3,838	451	455	442	435	434	434
Dean Dale SUD	Clay	2,150	2,218	2,218	2,218	2,218	2,218	163	159	151	149	149	149
Henrietta	Clay	3,321	3,425	3,425	3,425	3,425	3,425	664	669	657	650	649	649
Red River Authority of Texas	Clay	1,542	1,542	1,542	1,542	1,542	1,542	379	372	366	365	364	364
Windthorst WSC	Clay	469	480	480	480	480	480	140	141	139	138	138	138
Clay County Totals		**11,154**	**11,503**	**11,503**	**11,503**	**11,503**	**11,503**	**1,797**	**1,796**	**1,755**	**1,737**	**1,734**	**1,734**
County-Other, Cottle	Cottle	307	307	307	307	307	307	42	41	40	40	40	40
Paducah	Cottle	1,196	1,196	1,196	1,196	1,196	1,196	290	283	282	281	281	281
Red River Authority of Texas	Cottle	49	49	49	49	49	49	12	12	12	12	12	12
Cottle County Totals		**1,552**	**1,552**	**1,552**	**1,552**	**1,552**	**1,552**	**344**	**336**	**334**	**333**	**333**	**333**
County-Other, Foard	Foard	40	43	43	43	43	43	7	8	8	8	8	8
Crowell	Foard	986	995	995	995	995	995	138	133	131	131	131	130
Red River Authority of Texas	Foard	363	363	363	363	363	363	89	87	86	86	86	86
Foard County Totals		**1,389**	**1,401**	**1,401**	**1,401**	**1,401**	**1,401**	**234**	**228**	**225**	**225**	**225**	**224**
County-Other, Hardeman	Hardeman	1,022	1,002	962	941	906	871	163	154	144	141	135	130
Quanah	Hardeman	2,728	2,797	2,821	2,876	2,905	2,927	396	391	387	394	397	400
Red River Authority of Texas	Hardeman	524	584	637	690	741	789	129	141	151	163	175	186
Hardeman County Totals		**4,274**	**4,383**	**4,420**	**4,507**	**4,552**	**4,587**	**688**	**686**	**682**	**698**	**707**	**716**
County-Other, King	King	83	99	99	99	99	99	22	25	25	25	25	25
Red River Authority of Texas	King	217	217	217	217	217	217	53	52	52	51	51	51
King County Totals		**300**	**316**	**316**	**316**	**316**	**316**	**75**	**77**	**77**	**76**	**76**	**76**
Bowie	Montague	5,828	6,042	6,139	6,247	6,316	6,367	995	1,003	997	1,002	1,011	1,019
County-Other, Montague	Montague	9,621	9,950	10,081	10,233	10,321	10,378	1,164	1,162	1,144	1,144	1,150	1,156
Nocona	Montague	3,155	3,271	3,323	3,381	3,419	3,446	740	751	750	758	765	771
Nocona Hills WSC	Montague	536	556	565	575	581	586	105	106	106	107	108	108
Red River Authority of Texas	Montague	316	352	385	417	447	476	78	85	91	99	106	112
Saint Jo	Montague	1,051	1,089	1,107	1,126	1,139	1,148	155	156	155	155	157	158
Montague County Totals		**20,507**	**21,260**	**21,600**	**21,979**	**22,223**	**22,401**	**3,237**	**3,263**	**3,243**	**3,265**	**3,297**	**3,324**
Burkburnett	Wichita	11,004	11,405	11,721	11,941	12,153	12,331	1,461	1,460	1,457	1,462	1,483	1,505
County-Other, Wichita	Wichita	265	502	685	814	938	1,043	33	61	84	99	114	127
Dean Dale SUD	Wichita	1,066	1,103	1,134	1,156	1,176	1,194	81	79	77	78	79	80
Electra	Wichita	2,694	2,793	2,869	2,924	2,975	3,019	884	902	916	932	947	961
Harrold WSC	Wichita	43	45	47	48	49	50	12	13	13	13	13	14
Iowa Park	Wichita	6,492	6,728	6,913	7,044	7,168	7,274	884	884	882	885	898	911
Sheppard Air Force Base	Wichita	6,088	6,088	6,088	6,088	6,088	6,088	979	951	929	919	917	917
Wichita Falls	Wichita	104,830	108,653	111,648	113,752	115,762	117,471	16,873	16,987	17,055	17,159	17,422	17,677
Wichita Valley WSC	Wichita	3,145	3,256	3,343	3,404	3,462	3,512	370	369	368	368	373	379
Wichita County Totals		**135,627**	**140,573**	**144,448**	**147,171**	**149,771**	**151,982**	**21,577**	**21,706**	**21,781**	**21,915**	**22,246**	**22,571**
County-Other, Wilbarger	Wilbarger	1,324	1,335	1,305	1,279	1,233	1,178	210	204	196	192	185	176
Harrold WSC	Wilbarger	333	348	359	368	375	381	94	97	98	101	102	104
Red River Authority of Texas	Wilbarger	1,050	1,171	1,279	1,386	1,487	1,584	258	282	304	328	351	374
Vernon	Wilbarger	11,758	12,398	12,785	13,175	13,447	13,653	1,882	1,922	1,933	1,981	2,018	2,048
Wilbarger County Totals		**14,465**	**15,252**	**15,728**	**16,208**	**16,542**	**16,796**	**2,444**	**2,505**	**2,531**	**2,602**	**2,656**	**2,702**
Baylor SUD	Young	195	198	200	201	203	204	43	43	42	42	43	43
County-Other, Young	Young	339	436	506	581	653	723	41	51	58	66	74	82
Olney	Young	3,370	3,485	3,568	3,655	3,740	3,822	556	558	558	566	577	590
Young County Totals		**3,904**	**4,119**	**4,274**	**4,437**	**4,596**	**4,749**	**640**	**652**	**658**	**674**	**694**	**715**
Region B Totals		**206,307**	**213,930**	**218,928**	**222,760**	**226,142**	**228,973**	**33,380**	**33,627**	**33,635**	**33,855**	**34,293**	**34,720**

Table ES-3

Projected Water Demands (Acre-Feet/Yr.)

YEAR	2020	2030	2040	2050	2060	2070
MUN	33,380	33,627	33,635	33,855	34,293	34,720
MFG	2,427	2,635	2,635	2,635	2,635	2,635
PWR	7,742	7,742	7,742	7,742	7,742	7,742
MIN	5,203	4,342	2,978	1,837	1,701	1,701
IRR	96,498	96,498	96,498	96,498	96,498	96,498
STK	11,239	11,239	11,239	11,239	11,239	11,239
TOTAL	156,489	156,083	154,727	153,806	154,108	154,535

ES.4 Water Availability and Existing Water Supplies

In addition to surface water and groundwater supplies, Region B has available supplies from reuse and local supplies. The available supply from reuse is based on permitted authorizations and facilities. Currently, the majority of reuse in Region B is through the City of Wichita Falls indirect potable reuse project utilizing the bed and banks of Lake Arrowhead, which can supply up to 8 million gallons per day (MGD). The remaining reuse supplies are limited to municipal irrigation and/or use at the wastewater treatment facilities; however, the City of Bowie has sold nearly all of its wastewater effluent for mining purposes in the recent past.

Water users in the Region B planning area receive surface water from sources in the Brazos, Trinity, and Red River Basins. There are six major reservoirs in Region B that are used for water supply and several smaller reservoirs that were previously used for water supply or supply very small amounts of water. Other surface water sources include run-of-the-river diversion and local supplies used for livestock.

While most of the water used in Region B is surface water, groundwater provides a valuable resource for parts of the region. There are two major aquifers and two minor aquifers within the Region B planning area. The central and western part of the region is primarily supplied by two aquifers, the Seymour and the Blaine. The Seymour is designated a major aquifer and is currently used in Hardeman, Wilbarger, Wichita, Clay, Baylor, and Foard Counties. The Blaine is considered a minor aquifer and useable groundwater is limited to the westernmost portion of the region. The eastern part of the region relies on the Trinity Aquifer, a major aquifer that extends from Montague County south to Bandera County in Region J and east to Red River County in Region D. The Cross Timbers Aquifer is a newly designated minor aquifer that occurs in Archer, Clay, Baylor, Montague, Wichita, Wilbarger and Young Counties. Supplies from this formation are limited, especially in the western part of the region.

The total amount supply currently available to Region B is approximately 200,000 acre-feet per year, as shown in Table ES-4. This includes all groundwater in place and reliable supplies from surface water and reuse. By 2070, the supply to Region B decreases by about 20,000 acre-feet per year, which is mostly due to the reduced storage capacity of existing reservoirs due to sediment accumulation.

The supply to water users total approximately 140,000 acre-feet per year, which is less than the total available regional supply due to operational and contractual constraints, infrastructure limitations and water treatment capacities. In addition, shown in Table ES-5 is the source water supplies remaining as unused water.

Table ES-4
Summary of Reliable Supplies to Region B Water Users
-Values are in Acre-feet per Year-

	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Reservoirs in Region B	48,674	44,493	40,892	37,292	33,691	27,770
Reservoirs outside Region B[1]	3,112	2,941	2,770	2,599	2,428	2,256
Run-of-the-River Supplies	8,962	8,962	8,962	8,962	8,962	8,962
Local Supplies	9,384	9,384	9,384	9,384	9,384	9,384
Groundwater Supplies	120,704	103,332	109,345	110,330	112,521	121,754
Reuse	9,757	9,760	9,758	9,409	9,409	9,409
Total	**200,593**	**178,872**	**181,111**	**177,976**	**176,395**	**179,535**

1. The supply reported for reservoirs outside of Region B is the safe yield of Greenbelt Reservoir

Table ES-5

Source Water Supply Remaining

-Values are in Acre-feet per Year-

	2020	2030	2040	2050	2060	2070
Groundwater	50,333	32,830	40,068	41,583	43,801	53,019
Reuse	0	0	0	0	0	0
Surface Water	7,716	7,544	7,361	7,159	6,973	6,786
Total	**58,049**	**40,374**	**47,429**	**48,742**	**50,774**	**59,805**

ES.5 Identification of Water Needs

A comparison of current supply to demand was performed using the projected demands and the allocation of existing supplies as evaluated under drought of record conditions. Allocations of existing supplies to water users and providers were based on the most restrictive of current water rights, contracts, available yields for surface water and modeled available groundwater (MAG) for groundwater. For some aggregated water users (e.g., irrigation), reported historical use was also considered during the allocation process. Water quality was addressed only to the extent that supplies with known impaired water quality (e.g., nitrates and high salinity) were not allocated for municipal use.

On a regional basis, there is a projected shortage of 15,624 acre-feet in 2020 and a maximum project shortage of 36,084 acre-feet in 2070, as shown in Table ES-6. These needs are calculated by subtracting the regional demand from the total regional water supply. It includes both shortages for some water users and surpluses for others. Considering only the shortages, a summary of the need by county is presented in Table ES-7, which ranges from 24,745 acre-feet in 2020 to 41,256 acre-feet in 2070.

Table ES–6

Comparison of Supplies and Demands for Region B

-Values are in Acre-Feet per Year-

	2020	2030	2040	2050	2060	2070
Supply	140,854	136,964	132,308	127,804	124,257	118,421
Demand	156,489	156,083	154,727	153,806	154,108	154,535
Surplus/Storage	**-15,635**	**-19,119**	**-22,419**	**-26,002**	**-29,851**	**-36,114**

Table ES-7
Comparison of Supply and Demand by County
-Values are in Acre-feet per Year-

County	2020	2030	2040	2050	2050	2070
Archer	-905	-1,075	-1,015	-1,033	-1,058	-1,237
Baylor	0	0	0	0	0	0
Clay	-4	-10	-13	-17	-22	-89
Cottle	0	0	0	0	0	0
Foard	0	0	0	0	-13	-24
Hardeman	0	0	0	-23	-94	-177
King	0	0	0	0	0	0
Montague	-1,291	-226	-274	-110	-208	-305
Wichita	-20,830	-22,810	-25,291	-27,734	-30,296	-34,580
Wilbarger	-1,715	-2,320	-2,925	-3,531	-4,136	-4,788
Young (P)	0	0	0	0	0	-56
Total	**-24,745**	**-26,441**	**-29,518**	**-32,448**	**-35,827**	**-41,256**

A shortage occurs when developed supplies are not sufficient to meet projected demands. In Region B, there are twenty-seven water user groups with identified water quantity shortages during the planning period.

Total shortages for all water user groups are projected to be approximately 24,745 acre-feet per year in 2020, increasing to 29,518 acre-feet per year in 2040 and approximately 41,256 acre-feet per year by the year 2070. Table ES-8 lists the water user groups with projected water shortages.

Table ES-8

Projected Water Shortages for Water User Groups

-Values are in Acre-feet per Year-

Water User Group	2020	2030	2040	2050	2060	2070
Archer City	0	0	0	0	0	-20
Archer County MUD 1	-63	-61	-63	-65	-68	-78
Holliday	0	-4	-13	-22	-31	-64
Lakeside City	0	0	0	0	0	0
Scotland	0	-43	-47	-54	-63	-87
Windthorst WSC	-13	-30	-42	-54	-71	-121
County-Other - Archer	-38	-19	-13	-12	-11	-11
Irrigation - Archer	-470	-527	-585	-642	-699	-757
Mining - Archer	-325	-401	-265	-201	-137	-137
Red River Authority	0	0	0	-23	-48	-123
Crowell	0	0	0	0	-13	-24
Quanah	0	0	0	0	-36	-76
Manufacturing - Hardeman	0	0	0	0	-10	-29
Bowie	0	0	-17	-110	-208	-305
Mining - Montague	-1,291	-226	-257	0	0	0
Electra	-133	-164	-202	-246	-290	-395
Harrold WSC	-16	-20	-25	-30	-35	-49
Iowa Park	0	0	0	0	0	-35
Sheppard AFB	0	-14	-45	-78	-113	-225
Wichita Falls	0	-177	-831	-1,441	-2,162	-4,333
Irrigation - Wichita	-20,695	-22,452	-24,208	-25,964	-27,720	-29,476
Manufacturing - Wichita	0	0	0	0	-3	-103
Steam Electric Power - Wichita	0	-1	-2	-2	-4	-7
Vernon	0	0	0	0	0	-26
Manufacturing - Wilbarger	0	0	0	0	0	-13
Steam Electric Power - Wilbarger	-1,701	-2,302	-2,903	-3,504	-4,105	-4,706
Olney	0	0	0	0	0	-56
Total	**-24,745**	**-26,441**	**-29,518**	**-32,448**	**-35,827**	**-41,256**

Region B has two major water providers including the City of Wichita Falls and Wichita County Water Improvement District (WID) No. 2. The City of Wichita Falls is a regional provider for much of the water in Wichita, Archer, and Clay Counties. The City also provides water to customers as far away as the City of Olney in Young County. Considering current customer contracts and City demands, Wichita Falls has a firm need of 400 acre-feet per year in 2030, which increases to approximately 7,000 acre-feet per year by 2070. When applying the safe supply requirements of 20 percent above the firm demands for the City and customers without a specified contract amount (Holliday, Sheppard AFB and Wichita County Manufacturing), the safe supply need for Wichita Falls increases to over 2,500 acre-feet per year in 2020 and nearly 11,000 acre-feet by 2070.

Wichita County WID No. 2 provides irrigation water to users in Archer, Clay, and Wichita counties. The City of Wichita Falls and Wichita County WID No. 2 jointly provide water from Lake Kemp/Diversion system to the AEP steam electric power plant in Wilbarger County and the Dundee Fish Hatchery near Lake Diversion. For simplicity, the contracts for both of these customers and associated supplies are shown only on the WID. Based on this analysis, the needs for the Wichita County WID No. 2 are over 25,000 acre-feet per year in 2020 and increase to over 37,000 acre-feet per year by 2070.

The projected water shortages for the two Major Water Providers are shown in following

Tables ES-9 and ES-10.

Table ES-9
Projected Water Shortages for Major Water Provider
City of Wichita Falls
-Values are in Acre-feet per Year-

	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Total Firm Demand	27,589	27,744	27,797	27,888	28,148	28,403
Total Supplies	28,816	27,340	26,445	25,551	24,656	21,442
Supplies Less Current Customer Demand	1,227	-404	-1,352	-2,337	-3,492	-6,961
Firm Need by Category	2020	2030	2040	2050	2060	2070
Manufacturing	27	-10	-32	-55	-82	-162
Municipal	1,198	-394	-1,319	-2,279	-3,407	-6,792
Steam Electric Power	1	0	-2	-3	-4	-8
Total Firm Need	1,227	-404	-1,352	-2,337	-3,492	-6,961
Required Safe Supply for Customers	31,329	31,515	31,579	31,688	32,000	32,306
Customer Safe Supply Surplus/Shortage	-2,513	-4,175	-5,134	-6,137	-7,344	-10,864

Table ES- 10

Projected Water Shortages for Major Water Provider
Wichita County WID No. 2
-Values are in Acre-feet per Year-

	2020	2030	2040	2050	2060	2070
Total Firm Demand	49,518	49,518	49,518	49,518	49,518	49,518
Total Supplies	24,192	21,772	19,353	16,934	14,515	12,096
Supplies Less Current Customer Demand	-25,327	-27,746	-30,165	-32,584	-35,003	-37,422
Firm Need by Category	2020	2030	2040	2050	2060	2070
Irrigation	-21,426	-23,244	-25,062	-26,880	-28,698	-30,516
Livestock (Fish Hatchery)	-2,200	-2,200	-2,200	-2,200	-2,200	-2,200
Steam Electric Power	-1,701	-2,302	-2,903	-3,504	-4,105	-4,706
Total Firm Need	-25,327	-27,746	-30,165	-32,584	-35,003	-37,422

While many water user groups were not identified with a water quantity shortage, several were found to have little to no supplies above the projected demands, and thus water reliability concerns. The Region B Regional Water Planning Group recognized that these entities were likely to need to develop new supplies to provide a safe level of supply. To determine which entities may be impacted, a safe supply was defined as being able to meet the projected demands plus 20 percent of the demand. This was applied only to municipal and manufacturing water user groups. Using these criteria, twenty-six municipal and manufacturing water users were identified with safe supply shortages. Of these users, twenty-one are also shown to have firm supply shortages. The region shows a projected safe supply shortage of 3,797 acre-feet per year in 2020, and increasing to 12,399 acre-feet per year by 2070. In addition, two water users were found to have water quality that did not meet regulatory primary drinking water standards.

In summary, a total of 32 water user groups were identified with one or more of a quantity, reliability or quality need. Twenty-seven water user groups were identified with firm quantity needs. An additional five water user groups have projected safe supply shortages (reliability), and two municipal suppliers in Wilbarger County and two irrigation users were found to have water quality concerns.

ES.6 Water Management Strategies

Water management strategies were developed for water user groups to meet projected needs in the context of their current supply sources, previous supply studies and available supply within the region. Where site-specific data were available, this information was used. When specific well fields could not be identified, assumptions regarding well capacity, depth of well and associated costs were developed based on county and aquifer. The primary new surface water supplies are associated with the use of unappropriated water in the Wichita River Basin. Municipal and manufacturing strategies were developed to provide water of sufficient quantity and quality that is acceptable for its end use. Water quality issues affect water use options and treatment requirements. For the evaluations of the strategies, it was assumed that the final water product would meet existing state water quality requirements for the specified use. For example, a strategy that provided water for municipal supply would meet existing drinking water standards, while water used for mining may have a lower quality.

The consideration and selection of water management strategies for water user groups with needs followed TWDB guidelines and were conducted in open meetings with the Region B RWPG. In accordance with state guidance, the potentially feasible strategies were evaluated with respect to:

- Quantity, reliability and cost;
- Environmental factors, including effects on environmental water shortages, wildlife habitat and cultural resources;
- Impacts on water resources, such as playas and other water management strategies;
- Impacts on agriculture and natural resources; and
- Other relevant factors.

Water Conservation:

Water conservation strategies must be considered for all water users with a need. In Region B, this includes municipal, manufacturing, mining, agricultural water, and steam electric power users. Water conservation strategies will help address the needs through adoption of Advanced Conservation strategies.

Water conservation is a demand management strategy that can reduce projected demands and extend the availability of existing supplies. Water conservation strategies have been specifically identified for municipal, irrigation and mining demands. It is expected that conservation strategies will also be adopted by manufacturing and livestock demands, but these have not been quantified. Table ES-11 provides a summary of the conservation savings by decade.

Table ES-11

Summary of Conservation Savings by Water Use

Values are in Acre-feet per Year

Use	2020	2030	2040	2050	2060	2070
Municipal	405	1,112	1,378	1,647	1,909	1,961
Irrigation	830	2,494	4,061	8,594	10,834	13,860
Mining	1,301	1,086	746	461	426	426
SEP	3	2,306	2,908	3,510	4,112	4,716
Total	**2,539**	**6,998**	**9,093**	**14,212**	**17,281**	**20,963**

Major Water Providers:

As a major water provider, the City of Wichita Falls has developed strategies to meet both short term needs and a long term strategy to meet long term growth related demands. The recommended strategies shown in Table ES-12 could provide 169 acre-feet by the year 2020, 340 by 2030, with an additional 23,962 acre-feet of supply in 2040 when Lake Ringgold is completed. Table ES-13 shows the capital and annual costs associated with the recommended strategies.

Table ES-12

Recommended Water Management Strategies for Wichita Falls

-Values in Acre-Feet per Year-

	2020	2030	2040	2050	2060	2070
Wichita Falls Safe Supply Need	2,250	3,574	4,242	4,873	5,646	7,868
Wichita Falls Wholesale Customer Safe Supply Need	263	601	892	1,264	1,697	2,995
Total Safe Supply Need	**2,513**	**4,175**	**5,134**	**6,137**	**7,344**	**10,864**
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	169	340	512	686	871	884
Lake Ringgold	0	0	23,450	23,450	23,450	23,450
Total	**169**	**340**	**23,962**	**24,136**	**24,321**	**24,334**
Management Supply Factor	0.1	0.1	4.7	3.9	3.3	2.2

Table ES-13

Cost of Recommended Water Management Strategies for Wichita Falls

Recommended Strategies	Capital Cost	Annual Cost					
		2020	2030	2040	2050	2060	2070
Water Conservation	$0	$67,492	$135,896	$204,660	$274,544	$348,440	$353,540
Lake Ringgold	$442,867,000			$34,139,000	$34,139,000	$20,964,000	$20,964,000
Total	**$442,867,000**	**$67,492**	**$135,896**	**$34,343,660**	**$34,413,544**	**$21,312,440**	**$21,317,540**

As the other major water provider, Wichita County Water Improvement District No. 2 operates a canal system that distributes water to farmers from Diversion Lake in Wichita County, Archer County, and extends slightly into Clay County. To help meet the projected shortages, conservation to reduce water losses through its canal system was considered. Based on a study completed in 2009 nine canal segments, divided into three priority groups, should be considered for conversion to pipelines with estimated savings shown in Table ES-14. The capital and annual costs for conversion of the canals to pipe along with the water savings are presented in Table ES-15. In addition to this strategy, it is recommended that the Chloride Control Project for the Wichita River Basin be implemented to improve water quality in the Lake Kemp/Diversion system.

Table ES-14

Recommended Water Management Strategies for WCWID No. 2

-Values in Acre-Feet per Year-

	2020	2030	2040	2050	2060	2070
Need	25,327	27,746	30,165	32,584	35,003	37,422
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Canal Conversion to Pipeline	830	2,292	3,656	7,988	10,026	12,850
Management Supply Factor	0.0	0.1	0.1	0.2	0.3	0.3

Table ES-15

Cost of Recommended Water Management Strategies for WCWID No. 2

Recommended Strategies	Capital Cost	Annual Cost					
		2020	2030	2040	2050	2060	2070
Canal Conversion to Pipeline	$9,713,000	$722,000	$722,000	$7,000	$7,000	$7,000	$7,000

County Summaries:

There are ten full counties and one partial county in Region B, of which only two (Cottle and King Counties) show no projected water needs. Provided are the water issues of each county with water needs and the proposed water management strategies to meet the identified needs. For some counties, there are projected shortages that cannot be met through an economically viable project, and these "unmet needs" have also been identified, if present, by county.

Archer County **-** The maximum projected firm water need for Archer County is 1,237 acre-feet per year with most of this need (757 acre-feet per year) associated with an irrigation supply shortage. The remainder of the need is associated with insufficient supplies for existing contracts with Wichita Falls. As Wichita Falls develops its strategies to meet its contractual demands, these water needs will be met. The safe need for Archer County through the planning period is 1,503 acre-feet per year. This safe supply need will be met through Wichita Falls' supplies. Irrigation and Mining are shown to have an unmet need due to limited supplies. A summary of the recommended strategies for Archer County is shown in Table ES-16.

Table ES-16

Archer County Recommended Strategies Summary

Water User	Strategy Description	Max Supply (ac-ft/yr)	Max Cost/ 1,000 gal	Implement Decade
Archer City	Water Conservation	12	$1.35	2020
	By Contract	82	NA	2030
Archer County MUD 1	Water Conservation	7	$1.32	2020
	By Contract	21	NA	2030
	Voluntary Transfer	83	$3.50	2020
County-Other	Water Conservation	5	$1.48	2020
	Voluntary Transfer	37	$3.50	2020
City of Holliday	Water Conservation	14	$1.27	2020
	By Contract	103	NA	2020
Lakeside City	Water Conservation	6	$1.41	2020
	By Contract	2	NA	2030
Scotland	Water Conservation	12	$1.42	2020
	By Contract	50	NA	2030
	Voluntary Transfer	76	$5.00	2020
Windthorst WSC	Water Conservation	22	$1.24	2030
	By Contract	103	NA	2030
	Voluntary Transfer	93	$3.50	2020
Irrigation	Water Conservation	31	$0.03	2020
Mining	Water Conservation	121	$7.69	2020
TOTAL		**879**		
Unmet Max Irrigation Need of 726 acre-feet per year by 2070 and Unmet Max Mining Need of 280 acre-feet per year in 2030.				

***Baylor County* -** The maximum projected water need for Baylor County is 31 acre-feet per year and is associated with Baylor County Special Utility District (SUD). A summary of the recommended strategies for Baylor County is shown in Table ES-17.

Table ES-17

Baylor County Recommended Strategies Summary

Water User	Strategy Description	Max Supply (ac-ft/yr)	Max Cost/ 1,000 gal	Implement Decade
Baylor County SUD	Water Conservation	14	$1.32	2020
	New Well in Seymour Aquifer	31	$1.09	2020
TOTAL		45		

***Clay County* -** The maximum projected safe need for Clay County is 247 acre-feet per year, and a summary of the recommended strategies for Clay County is shown in Table ES-18.

Table ES-18

Clay County Recommended Strategies Summary

Water User	Strategy Description	Max Supply (ac-ft/yr)	Max Cost/ 1,000 gal	Implement Decade
County-Other	Water conservation	22	$1.26	2020
	Voluntary Transfer	70	$3.50	2020
Red River Authority	Water conservation	32	$3.37	2030
	Treated Waterline[1]	100	$5.08	2020
TOTAL		224		
ALTERNATE STRATEGIES – NONE IDENTIFIED				
[1]This project will convert a raw water contract to treated water				

***Foard County* -** Foard County has sufficient supplies to meet its needs with only a small supply need associated with the City of Crowell. Greenbelt MIWA has sufficient supplies to meet the needs of Crowell including a safe need of 50 acre-feet per year in 2070. A summary of the recommended strategies for Foard County is shown in Table ES-19.

Table ES-19

Foard County Recommended Strategies Summary

Water User	Strategy Description	Max Supply (ac-ft/yr)	Max Cost/ 1,000 gal	Implement Decade
Crowell	Water Conservation	6	$1.29	2020
	Voluntary Transfer	44	$3.50	2050
TOTAL		50		
ALTERNATE STRATEGIES – NONE IDENTIFIED				

Hardeman County **-** The maximum projected water need for Hardeman County is 177 acre-feet per year with all being associated with an irrigation supply shortage. Also there is a safe supply need of 391 acre-feet per year for Quanah, Manufacturing and Red River Authority. A summary of the recommended strategies for Hardeman County is shown in Table ES-20.

Table ES-20

Hardeman County Recommended Strategies Summary

Water User	Strategy Description	Max Supply (ac-ft/yr)	Max Cost/ 1,000 gal	Implement Decade
Quanah	Water Conservation	20	$1.26	2020
	Voluntary Transfer	136	$3.50	2050
Manufacturing	Voluntary Transfer	126	$3.50	2030
Red River Authority	Water Conservation	16	$3.37	2020
	Voluntary Transfer	93	$3.50	2050
TOTAL		391		
ALTERNATE STRATEGIES – NONE IDENTIFIED				

Montague County **-** The maximum projected water need for Montague County is 1,291 acre-feet per year and the maximum safe need is 546 acre-feet per year. A summary of the recommended strategies for Montague County is shown in Table ES-21.

Table ES-21

Montague County Recommended Strategies Summary

Water User	Strategy Description	Max Supply (ac-ft/yr)	Max Cost/ 1,000 gal	Implement Decade
Bowie	Water Conservation	57	$1.24	2020
	Wastewater Reuse	550	$3.62	2020
County Other	Water Conservation	63	$1.24	2020
	Voluntary Transfer	23	$3.50	2020
Nocona Hills WSC	Water Conservation	6	$1.39	2020
Mining	Water Conservation	910	$7.67	2020
TOTAL		1,609		
Unmet Mining Need of 381 acre-feet per year in 2020.				
Unmet Safe Bowie Need of 90 acre-feet per year by 2070.				
ALTERNATE STRATEGIES – NONE IDENTIFIED				

Wichita County - The maximum projected water need for Wichita County is 34,580 acre-feet per year with most of this need (29,476 acre-feet per year) associated with an irrigation supply shortage. The safe need for Wichita County is 39,085 acre-feet per year. Most of the needs in the county will be met through strategies developed by Wichita Falls and WCWID No.2. A summary of the recommended strategies is presented in Table ES-22.

Table ES-22

Wichita County Recommended Strategies Summary

Water User	Strategy Description	Max Supply (ac-ft/yr)	Max Cost/ 1,000 gal	Implement Decade
Electra	Water Conservation	48	$1.23	2020
	By Contract	206	NA	2030
	Voluntary Transfer from Iowa Park	333	$5.00	2020
Iowa Park	Water Conservation	47	$1.27	2020
	By Contract	343	NA	2030
Wichita Falls	Water Conservation	884	$1.23	2020
	Lake Ringgold	23,450	$4.47	2040
Sheppard AFB	Water Conservation	44	$1.24	2020
	By Contract	364	NA	2020
Irrigation	Water Conservation	13,829	$0.17	2020
	Chloride Control Project	5,800	N/A	2020
Manufacturing	By Contract	513	NA	2020
Steam Electric	Water Conservation	10	NA	2020
TOTAL		45,871		
Unmet Irrigation Need over planning period, with a maximum of 15,520 acre-per year by 2070.				
ALTERNATE STRATEGIES – NONE IDENTIFIED				

***Wilbarger County* -** The maximum projected need for Wilbarger County is 5,434 acre-feet per year, with most of that need (4,706 acre-feet per year) being associated with steam electric power. Wilbarger County has limited water supplies available for water management strategies. As a result, the only option for steam electric power is alternative cooling technology. Water conservation, direct reuse and developing additional wells for Vernon are the recommended strategies for Wilbarger County. These strategies are summarized in Table ES-23.

Table ES-23

Wilbarger County Recommended Strategies Summary

Water User	Strategy Description	Max Supply (ac-ft/yr)	Max Cost/1,000 gal	Implement Decade
Harrold WSC	Conservation	6	$1.38	2020
	Voluntary Transfer (Electra)	67	$5.00	2020
Red River Authority	Conservation	33	$3.37	2020
Vernon	Conservation	415	$1.24	2030
	New Groundwater	600	$1.23	2020
Manufacturing	Voluntary Transfer (Vernon)	223	NA	2020
Steam Electric	Alternative Cooling	4,706	$9.93	2020
TOTAL		6,050		
Unmet Steam Electric Power Need in 2020 of 1,701 acre-feet				
ALTERNATE STRATEGIES – NONE IDENTIFIED				

***Young County* -** The maximum projected water need for Young County is 56 acre-feet per year and a safe need of 195 acre-feet per year. The City of Olney has in place a 10" raw water line from Lake Kickapoo to Olney that could be utilized to shore up its supplies in Lake Olney-Cooper. With this additional water, Olney would have sufficient supplies to meet the small County-Other needs identified in the Region B portion of Young County. A summary of the recommended strategies is shown in Table ES-24.

Table ES-24

Young County Recommended Strategies Summary

Water User	Strategy Description	Max Supply (ac-ft/yr)	Max Cost/ 1,000 gal	Implement Decade
County Other	Water Conservation	4	$1.51	2030
	Voluntary Transfer	16	$3.50	2030
Olney	Water Conservation	152	$1.23	2020
	Voluntary Transfer	150	$2.50	2050
TOTAL		322		
ALTERNATE STRATEGIES – NONE IDENTIFIED				

Summaries of population, demand, needs and water management strategies are included in the DB22 tables in Appendix G.

ES.7 Unique Stream Segments and Reservoir Site and Other Recommendations

The Region B Regional Water Planning Group (RWPG) did not recommend any streams or river segments be designated as "Unique Stream/River Segments", however, the RWPG did recommend that the Lake Ringgold Reservoir Site be recognized and designated as a site of unique value. Lake Ringgold is a recommended water management strategy for the City of Wichita Falls, and it is important that this site be protected under the Texas Water Code until the required applications and permits for the site are filed.

In addition, the RWPG recommended that the Chloride Control Project on the Wichita River and the Pease River be made a regional priority in order to enhance the water quality of Lake Kemp and Lake Diversion, and reclaim those lakes as a viable cost effective short term and long term regional water supply.

CHAPTER 1

DESCRIPTION OF REGION

2021 FINAL PLAN

REGION B

OCTOBER 2020

CHAPTER 1

DESCRIPTION OF REGION
2021 FINAL PLAN
REGION B

1.1 Region B Overview

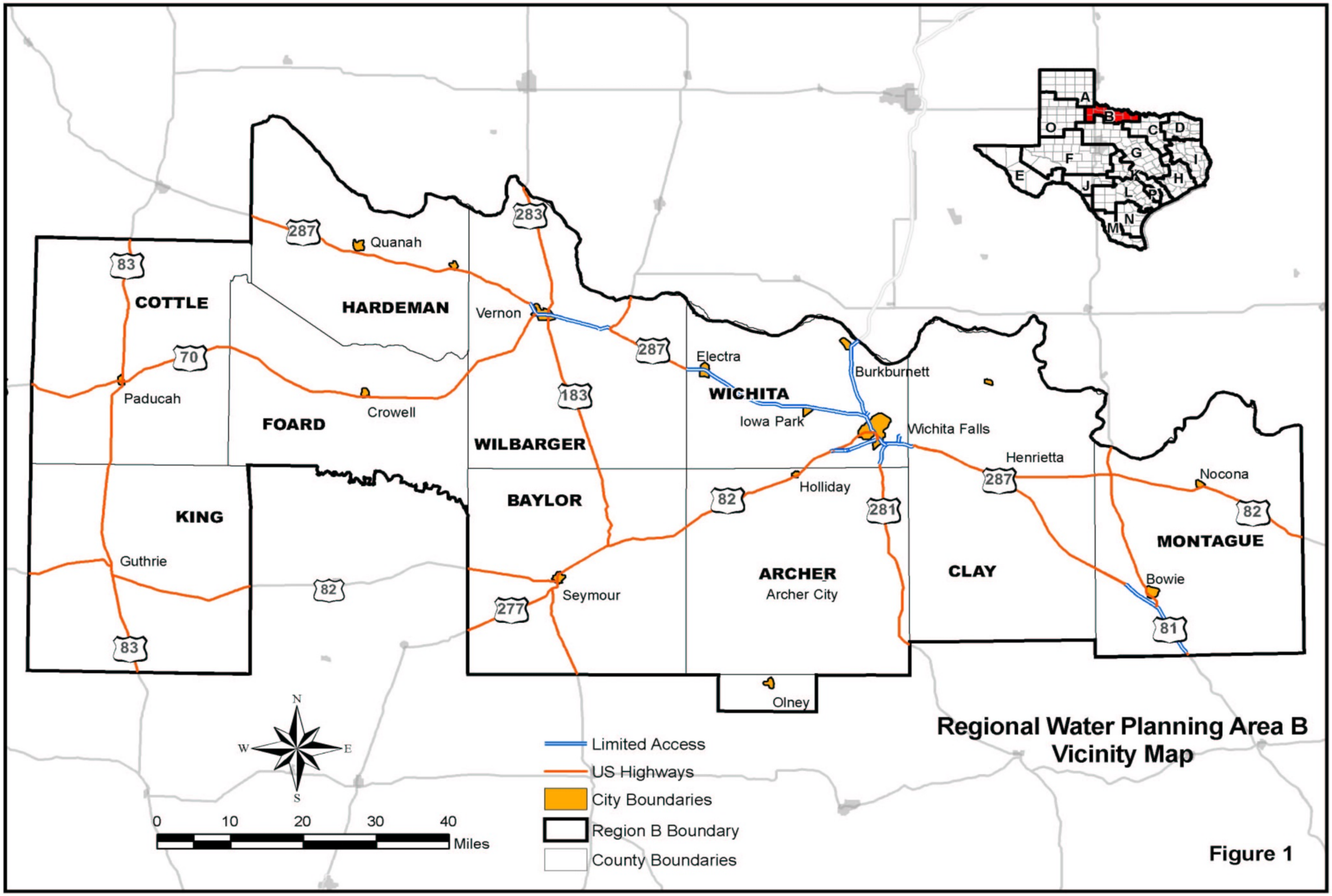
Senate Bill 1 of the 75th Texas Legislature was passed in 1997 to set the process of developing a comprehensive state water plan. To accomplish this task, the state was divided into 16 regional water planning groups. This report describes Region B as designated by Senate Bill 1. Region B is comprised of ten entire counties and a portion of one county in north central Texas. Specifically, those counties are Archer, Baylor, Clay, Cottle, Foard, Hardeman, King, Montague, Wichita, Wilbarger, and the City of Olney in Young County. Figure 1 shows the region, cities, towns, and the counties it encompasses.

Region B lies mainly in the Red River Basin, however, southern portions of Archer, Clay, and Montague Counties lie in the Trinity River Basin, and southern portions of Archer, Baylor, and King Counties lie in the Brazos River Basin, as shown on the Surface Water Map in Figure 2.

Based on the latest 2018 estimates, the total population of the region was reported to be 197,701, with the largest population center, the City of Wichita Falls, being 104,576 or 53 percent of the total. The second largest city was Burkburnett with a population of 11,250.

1.2 Population And Demographic Data

In general, most of the population is concentrated in eastern portions of the region with over one-half located in and around Wichita Falls. The 2018 estimated population density of the region ranged from a high of 210 persons per square mile (Wichita County) to a low of less than one person per square mile (King County). Regional population is forecasted to increase by approximately 11 percent over the study period. The forecasts of projected populations will be examined in more detail in Chapter 2 of this report. Table 1-1 shows the 2010 census population by county and the 2018 estimated population. Tables 1-2 through 1-5 give a more in-depth breakdown of the regional demographics as of 2017.



COTTLE
HARDEMAN
FOARD
WILBARGER
WICHITA
KING
BAYLOR
ARCHER
CLAY
MONTAGUE
Quanah
Vernon
Paducah
Crowell
Electra
Burkburnett
Iowa Park
Wichita Falls
Henrietta
Nocona
Holliday
Guthrie
Seymour
Archer City
Bowie
Olney
287
283
83
70
183
82
281
277
81
A
B
C
D
O
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G
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H
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K
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P
N
M
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S
0
10
20
30
40
Miles
Limited Access
US Highways
City Boundaries
Region B Boundary
County Boundaries
Regional Water Planning Area B
Vicinity Map
Figure 1

Table 1-1:
County Populations

County	Area (sq. mi)	2010 Population	2018 (Est.) Population	% Change	2010 Density people/sq.mi.
Archer	910	9,054	8,786	-3.0%	10
Baylor	871	3,726	3,582	-3.9%	4
Clay	1,098	10,752	10,456	-2.8%	10
Cottle	901	1,505	1,389	-7.7%	2
Foard	707	1,336	1,200	-10.2%	2
Hardeman	695	4,139	3,922	-5.2%	6
King	912	286	277	-3.1%	< 1
Montague	931	19,719	19,596	-0.6%	21
Wichita	628	131,500	132,064	0.4%	210
Wilbarger	971	13,535	12,820	-5.3%	13
Young	185	3,746	3,609	-3.7%	20

The following tables describe the demography of the region as 2017 (Est.).

Table 1-2:
2017 (Est.) Demographics – Breakdown by Race

	Percentage Of Population That Is…				
County	White	Black	Hispanic	Asian	Other
Archer	87.8%	0.4%	9.5%	0.2%	2.1%
Baylor	83.1%	2.0%	12.6%	0.1%	2.2%
Clay	91.2%	0.5%	5.2%	0.3%	2.8%
Cottle	65.0%	9.8%	24.3%	0.0%	0.9%
Foard	76.8%	4.8%	17.6%	0.3%	0.5%
Hardeman	64.9%	6.0%	26.8%	0.3%	2.0%
King	85.4%	0.0%	13.8%	0.0%	0.8%
Montague	86.1%	0.3%	11.3%	0.3%	2.0%
Wichita	65.3%	10.0%	19.4%	2.1%	3.2%
Wilbarger	57.6%	8.6%	30.0%	0.9%	2.9%
Young	77.1%	1.2%	19.5%	0.3%	1.9%
Average	76.4%	4.0%	17.3%	0.4%	1.9%

Table 1-3:
2017 (Est.) Demographics – Breakdown by Age

County	Percentage of Population That is Age…							
	<5	5-17	18-24	25-44	45-64	65-74	75-84	85
Archer	6.0	15.6	7.9	22.4	29.2	10.5	6.8	1.7
Baylor	7.3	15.9	6.9	19.9	26.8	11.9	8.8	2.3
Clay	5.7	15.1	6.9	20.8	30.3	12.8	6.7	1.9
Cottle	6.3	16.2	8.0	17.3	24.2	13.9	9.4	3.8
Foard	6.3	14.2	6.6	17.6	27.8	13.7	9.9	3.0
Hardeman	7.8	17.4	8.1	21.3	26.9	10.9	6.2	1.9
King	5.2	13.6	10.3	16.9	35.4	9.4	7.5	2.3
Montague	7.3	16.0	6.9	21.9	26.7	12.5	7.2	2.0
Wichita	8.0	15.8	12.4	26.6	23.3	8.3	4.8	1.5
Wilbarger	8.1	16.7	8.3	24.8	24.6	10.2	5.8	1.7
Young	8.1	16.8	7.5	22.5	25.3	11.4	6.8	2.1

Table 1-4:
2017 (Est.) Demographics – Breakdown by Income and Education

County	Median Family Income	High School Diploma or Better	Bachelor's Degree or Better	Family Income Below Poverty Level
Archer	$58,311.00	91.2%	23.6%	10.1%
Baylor	$37,013.00	87.8%	24.8%	17.7%
Clay	$53,438.00	89.4%	17.9%	11.8%
Cottle	$36,201.00	75.4%	16.7%	21.2%
Foard	$35,007.00	77.5%	16.7%	18.0%
Hardeman	$39,022.00	77.5%	14.4%	18.0%
King	$56,346.00	80.2%	19.8%	13.9%
Montague	$47,590.00	82.7%	16.2%	15.3%
Wichita	$44,593.00	86.2%	22.4%	16.8%
Wilbarger	$40,353.00	79.2%	15.2%	16.4%
Young	$44,909.00	82.6%	19.6%	15.8%
Average	$44,798.00	82.7%	18.8%	15.9%

Table 1-5:
2017 (Est.) Demographics – Breakdown by Occupation

County	Percentage of Population That Work In…						
	Management	Service	Sales	Farming	Construction	Production	Unemployed
Archer	34.2%	16.5%	25.3%	6.3%	6.6%	14.2%	3.1%
Baylor	32.3%	10.2%	24.3%	7.9%	16.0%	4.0%	3.3%
Clay	25.5%	16.5%	24.5%	7.6%	7.1%	13.9%	3.2%
Cottle	21.7%	29.1%	17.7%	11.7%	10.6%	4.9%	4.3%
Foard	22.1%	22.7%	23.5%	4.9%	10.3%	7.1%	2.9%
Hardeman	33.5%	20.2%	20.1%	11.5%	1.8%	15.8%	3.6%
King	38.1%	8.1%	15.1%	33.5%	1.1%	2.3%	2.8%
Montague	25.7%	15.1%	22.8%	7.4%	11.5%	17.3%	3.2%
Wichita	32.7%	20.7%	23.8%	3.9%	6.4%	11.8%	3.4%
Wilbarger	26.5%	24.7%	22.3%	4.8%	6.6%	15.1%	4.1%
Young	24.4%	18.2%	27.1%	14.5%	8.6%	14.3%	3.2%
Average	28.8%	18.4%	22.4%	10.4%	7.9%	11.0%	3.4%

1.3 Water Use Demand Centers

The City of Wichita Falls is the largest demand center in the region. Other demand centers include Vernon, Burkburnett, Iowa Park, Bowie, Olney, Henrietta, Nocona, Seymour, Electra, Quanah and Archer City. Table 1-6 below shows the population and water usage of these demand centers and also the gallons per capita per day (GPCD) usage for each center.

Table 1-6:
Regional Demand Centers

County	City	2018 (Est.) Population	2018 (Est.) Municipal Water Use (Ac-Ft)	Water Use (GPCD)
Archer	Archer City	1,744	283	145
Baylor	Seymour	2,613	500	171
Clay	Henrietta	3,062	645	188
Hardeman	Quanah	2,482	389	140
Montague	Bowie	5,059	918	162
Montague	Nocona	2,981	731	219
Wichita	Burkburnett	11,250	1,613	128
Wichita	Electra	2,706	918	303
Wichita	Iowa Park	6,370	934	131
Wichita	Wichita Falls	104,576	17,923	153
Wilbarger	Vernon	10,384	1,780	153
Young	Olney	3,111	547	157

While the population of Region B is only expected to reach near 229,000 by 2070, the Dallas-Fort Worth Metroplex, located just east of the region, is expected to top 9 million. This population could likely impose increasing pressures on the water base recreational resources of the Region, as the number of people willing to travel into Region B for recreational purposes increase.

1.4 Water Supply and Use

Water providers have continuously strived to develop the water resources in Region B so that they can deliver potable water to the people, irrigation water to the farmers and ranchers, and water to promote industrial and economic growth. In 1901, the dam at Lake Wichita in Wichita County was completed, signifying the beginning of 90 years of water management for recreation, irrigation, and human consumption for north central Texas. In 1924, the dam at Lake Kemp was completed, making it one of the largest man-made lakes in the world. The lake was originally designed for flood prevention and water supply, however, soon after construction, it was determined that its water was too saline to drink. This led to the discovery of natural salt-water springs in Foard, King, and Knox Counties which have caused the water in the Big Wichita and Pease Rivers to be very difficult to treat for human consumption, consequently it has been only used for irrigation and steam electric power purposes until recently. This natural phenomenon has prompted the Red River Authority to initiate the Red River Chloride Control Project on the Big Wichita River. By building brine lakes and low-flow dams, the amount of dissolved solids and chlorides in the water has been reduced. As a result, water from Lake Kemp may be utilized for other uses. In fact, in May 2009 the City of Wichita Falls completed a 10 MGD reverse osmosis (R.O.) plant to treat Lake Kemp water and supplement their current water supply.

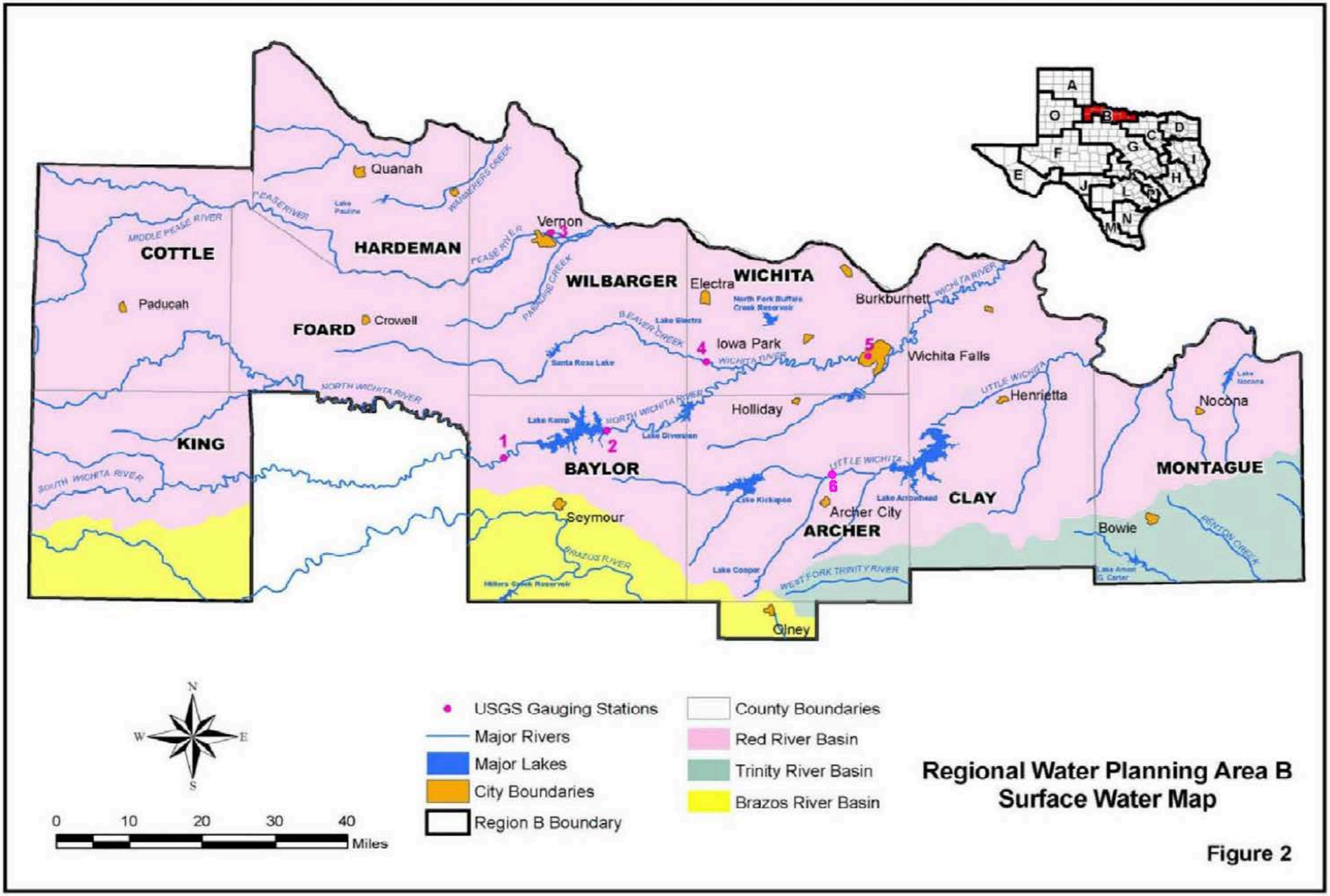
There are 10 significant lakes and 4 major streams that are used for water supply in the region. Figure 2 - "Surface Water Map" shows the location of the major surface water sources in Region B. Charts 1 through 12 depict the average monthly and average annual stream flows in cubic feet per second (CFS) at various USGS gauging stations which are shown on Figure 2. (NOTE: The site number shown for each chart represents the USGS gauging station shown on Figure 2.)

Table 1-7 shows the Year 2020 firm yield for each significant lake in Region B.

Table 1-7:
Year 2020 Firm Yields for Lakes in Region B

Water Source	Basin	Lake Firm Yield (ac-ft)	Conservation Capacity (ac-ft)
Lake Kemp/Diversion	Red River	44,000	221,929
Lake Kickapoo	Red River	11,006	86,345
Lake Arrowhead	Red River	20,764	230,359
Amon Carter Lake	Trinity/Red River	1,689	27,541
Lake Electra	Red River	454	5,606
Lake Nocona	Red River	1,260	20,917
Olney Lake	Red River	268	4,546
Santa Rosa Lake	Red River	3,075	8,245
North Fork Buffalo Cr.	Red River	840	14,378

In addition to the lakes listed in the previous table, some municipalities and water supply corporations obtain their raw water from wells.



COTTLE
HARDEMAN
WILBARGER
WICHITA
FOARD
KING
BAYLOR
ARCHER
CLAY
MONTAGUE
Quanah
Vernon
Electra
Burkburnett
Paducah
Crowell
Iowa Park
Wichita Falls
Holliday
Henrietta
Nocona
Seymour
Archer City
Bowie
Olney
PEASE RIVER
MIDDLE PEASE RIVER
NORTH WICHITA RIVER
SOUTH WICHITA RIVER
WICHITA RIVER
BEAVER CREEK
LITTLE WICHITA
BRAZOS RIVER
WEST FORK TRINITY RIVER
Lake Kemp
Lake Diversion
Santa Rosa Lake
Lake Electra
Lake Kickapoo
Lake Arrowhead
Lake Cooper
1
2
3
4
5
6
N
S
E
W
USGS Gauging Stations
Major Rivers
Major Lakes
City Boundaries
Region B Boundary
County Boundaries
Red River Basin
Trinity River Basin
Brazos River Basin
0
10
20
30
40
Miles
Regional Water Planning Area B
Surface Water Map
Figure 2

Chart-1:

Streamflow Data – Site 1

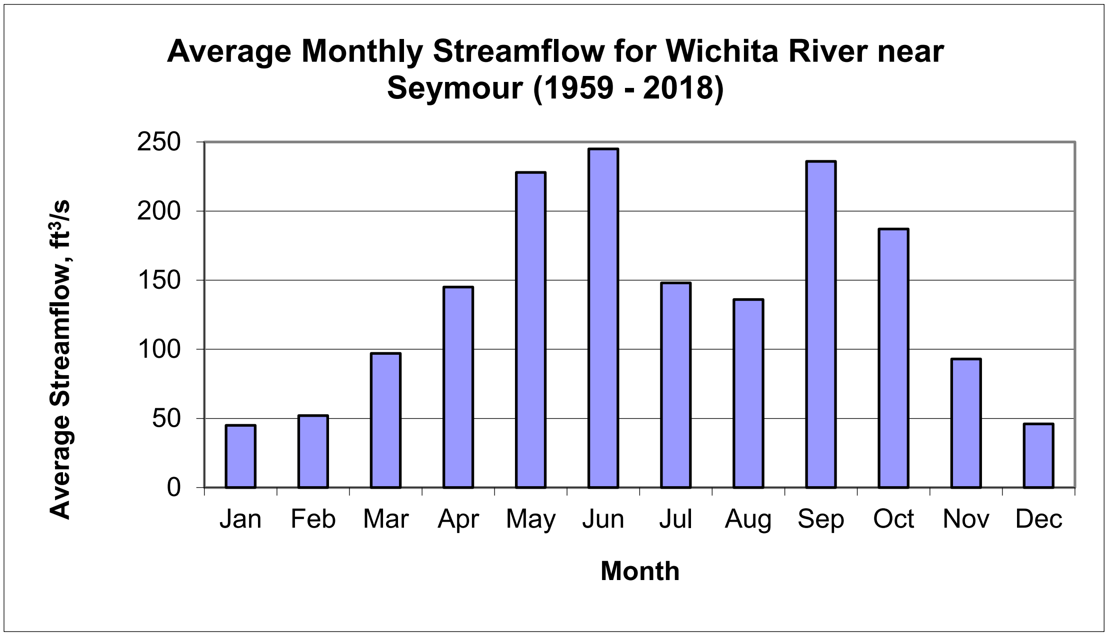
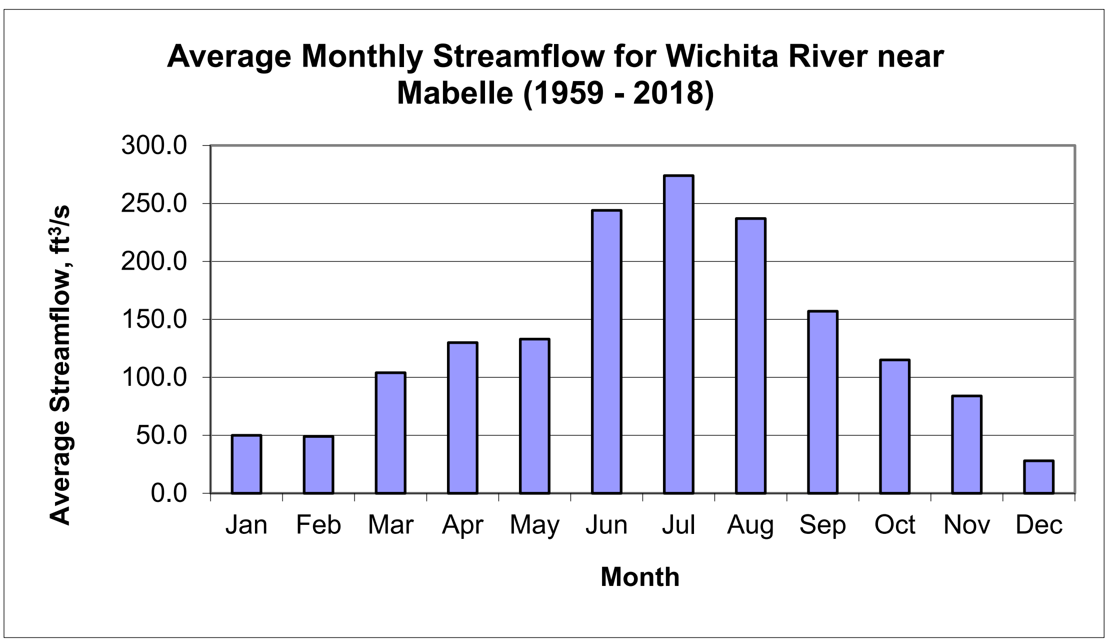


Chart-2:

Streamflow Data – Site 2



Note: Streamflows at this site are influenced by releases from Lake Kemp for irrigation and industrial diversions.

Chart-3:

Streamflow Data – Site 3

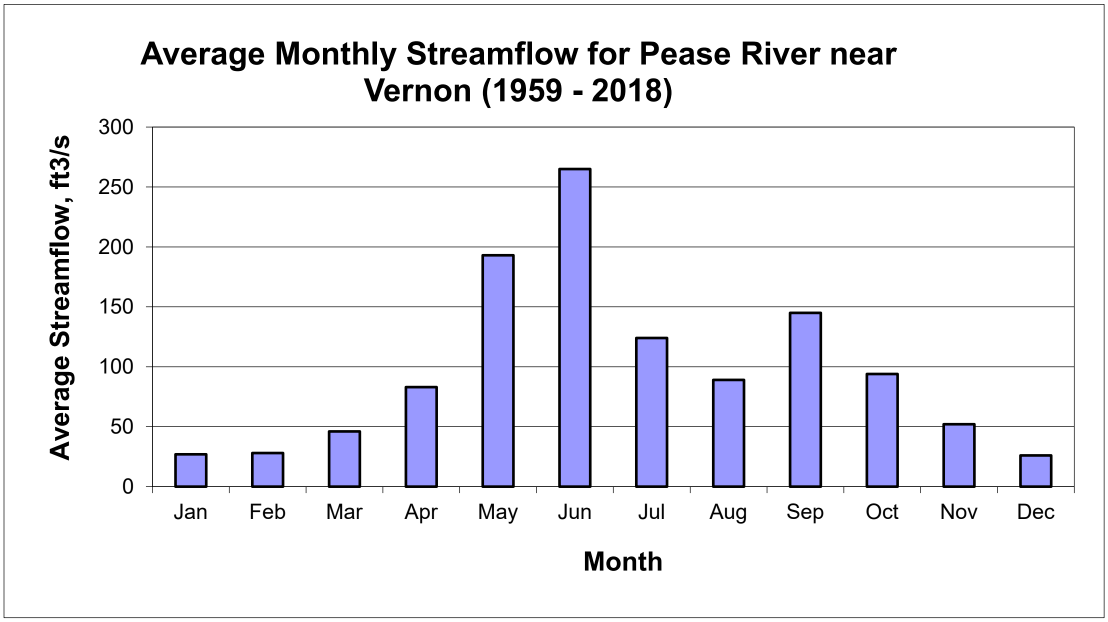


Chart-4:

Streamflow Data – Site 4

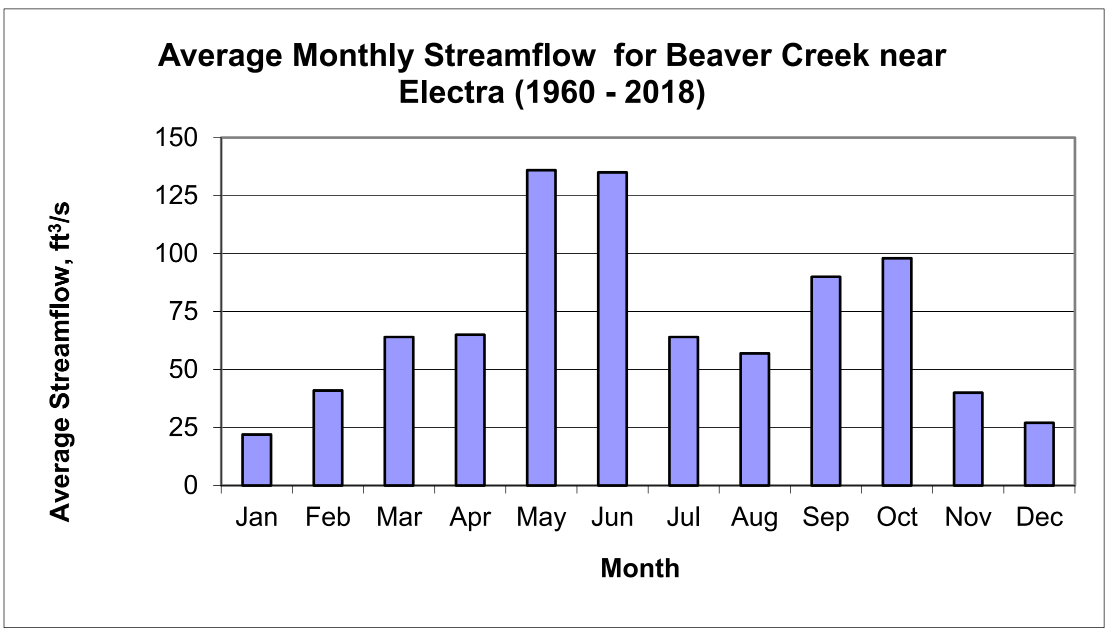


Chart-5:

Streamflow Data – Site 5

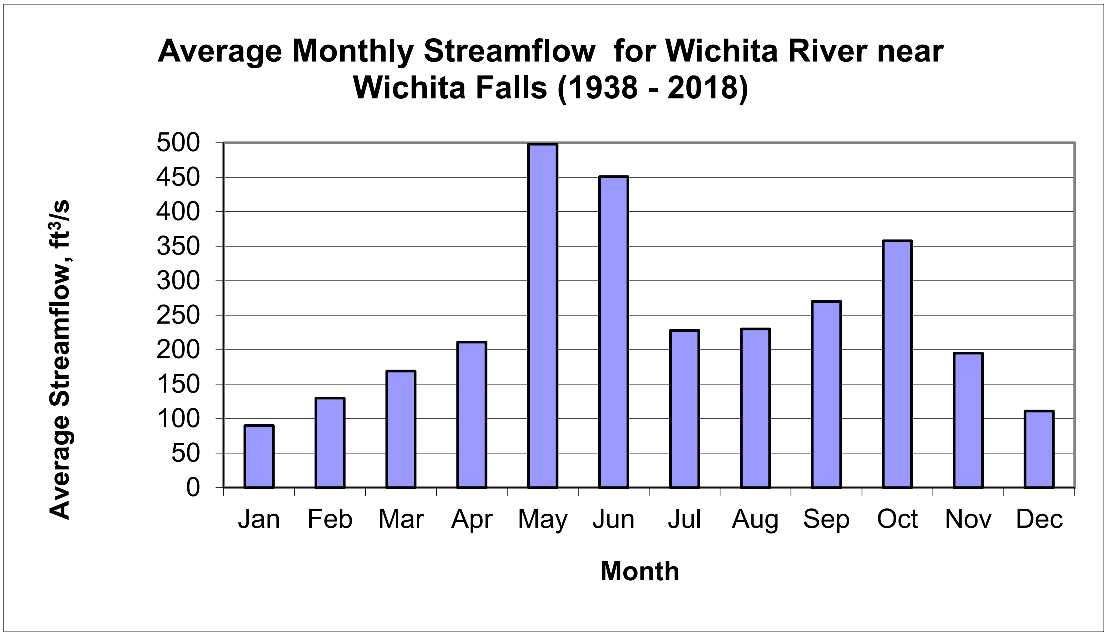


Chart-6:

Streamflow Data – Site 6

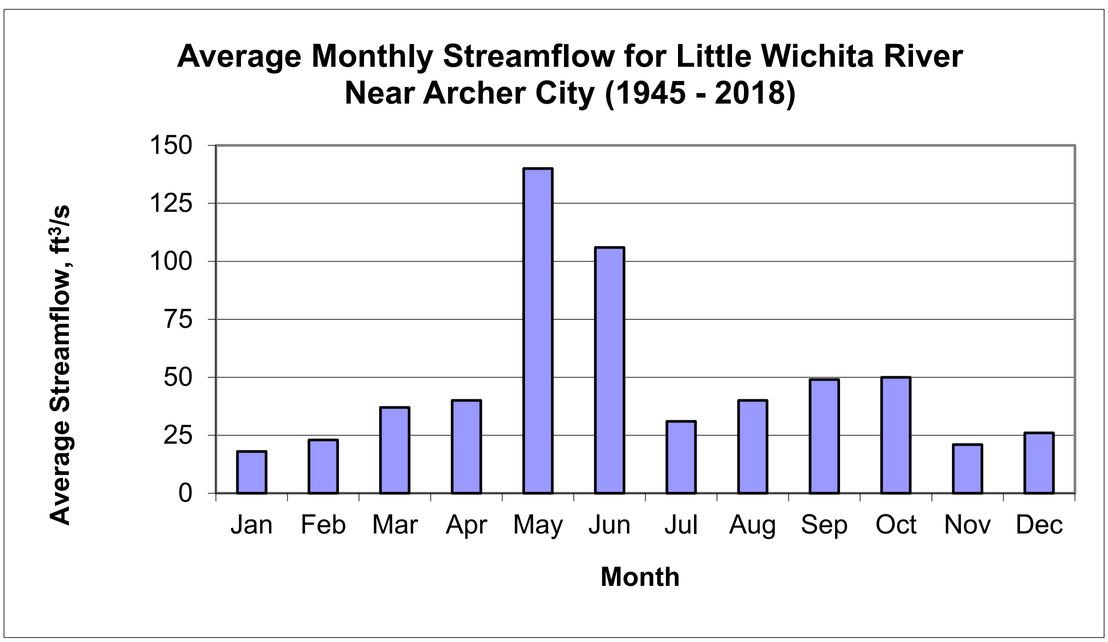


Chart-7:

Streamflow Data – Site 1

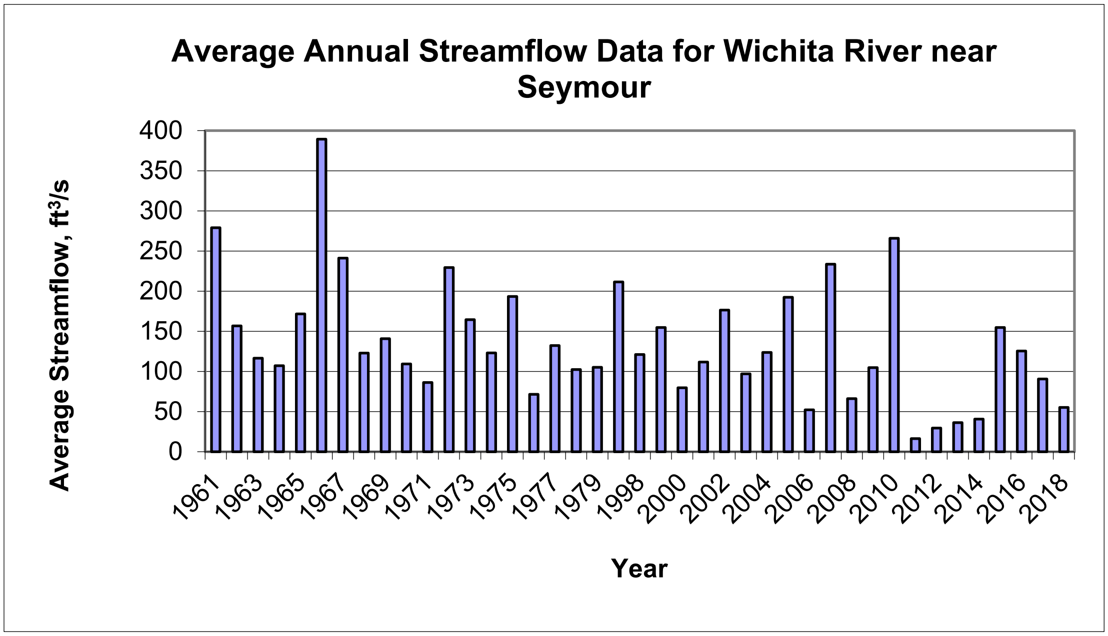


Chart-8:

Streamflow Data – Site 2

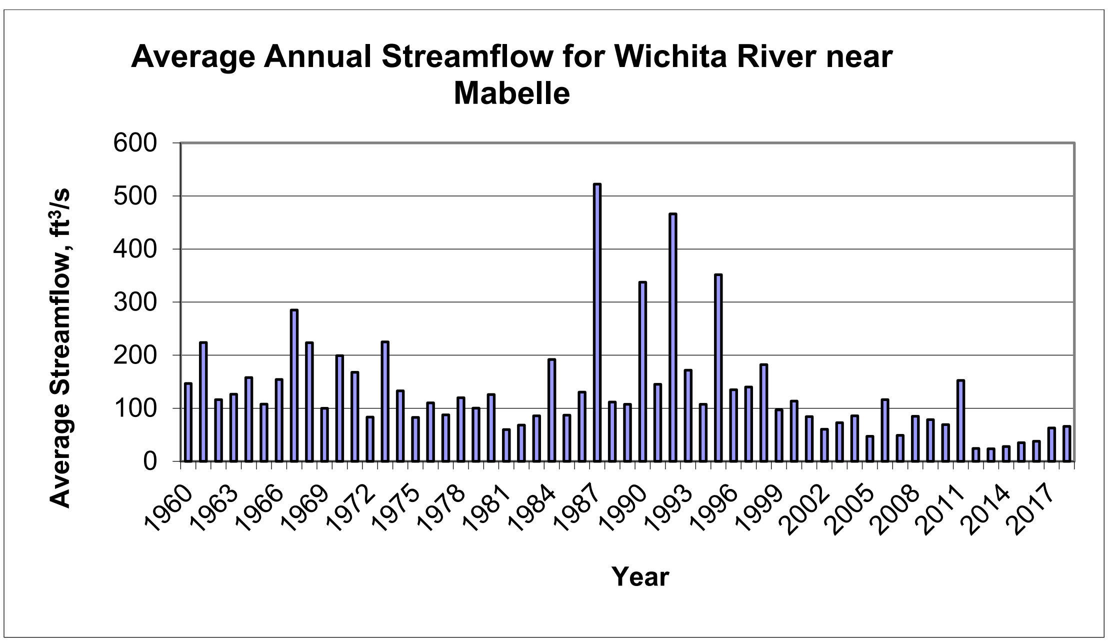


Chart-9:

Streamflow Data – Site 3

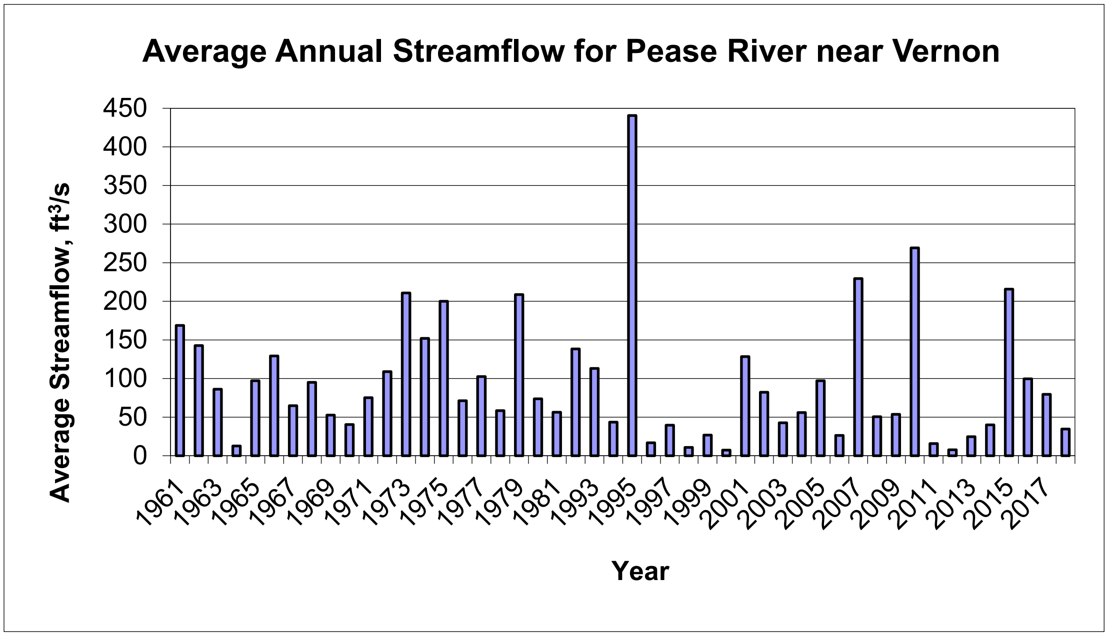


Chart-10:

Streamflow Data – Site 4

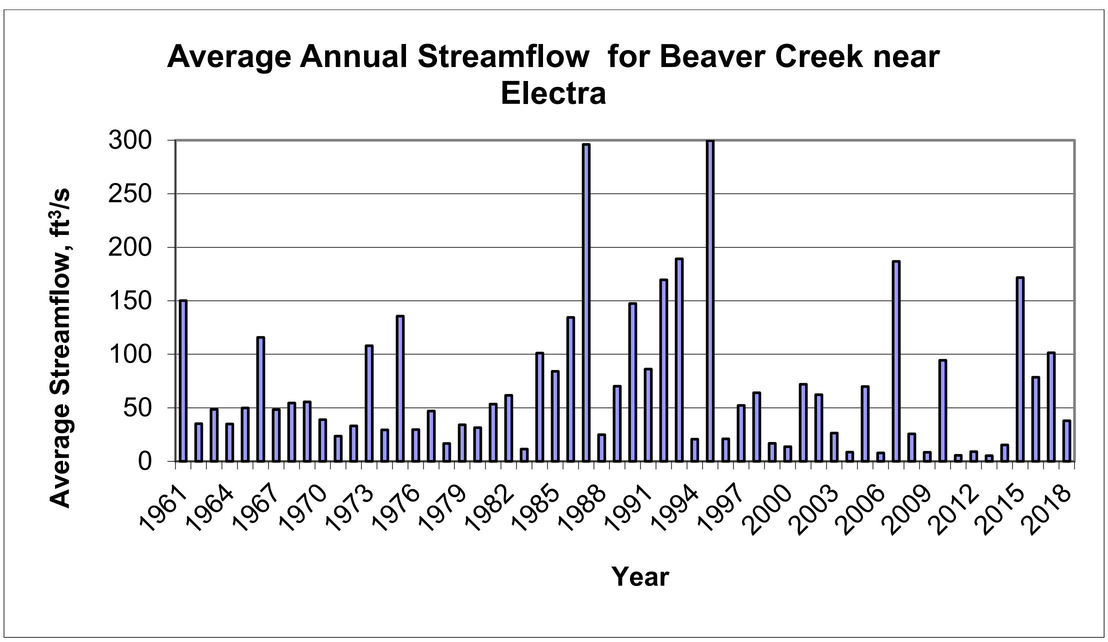


Chart-11:

Streamflow Data – Site 5

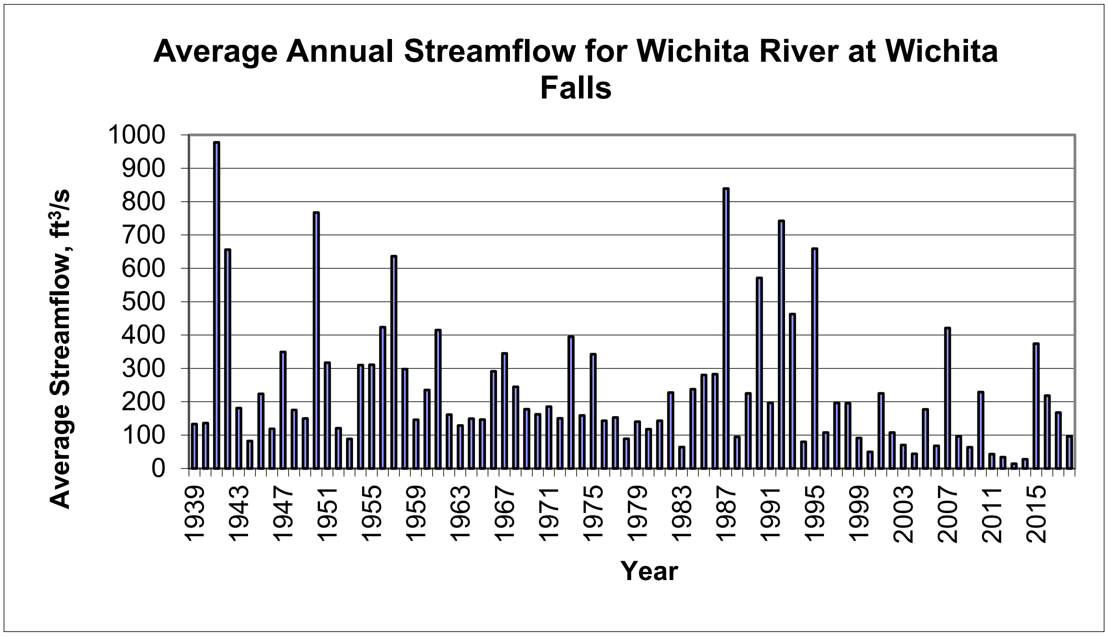
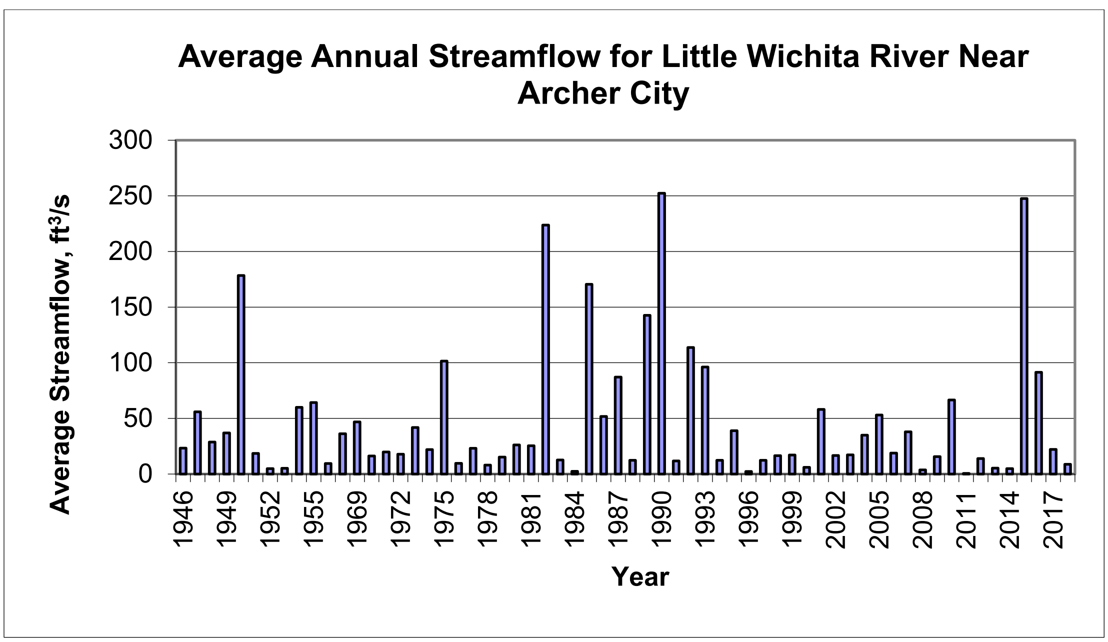


Chart-12:

Streamflow Data – Site 6



There are two major aquifers (Seymour and Trinity) and two minor aquifers (Blaine and Cross Timbers) in Region B. The Seymour Aquifer, found in the western portions of the region, is utilized for irrigation purposes in addition to being pumped for municipal use by the cities of Vernon, Burkburnett, and Seymour as well as rural water supply corporations and rural communities.

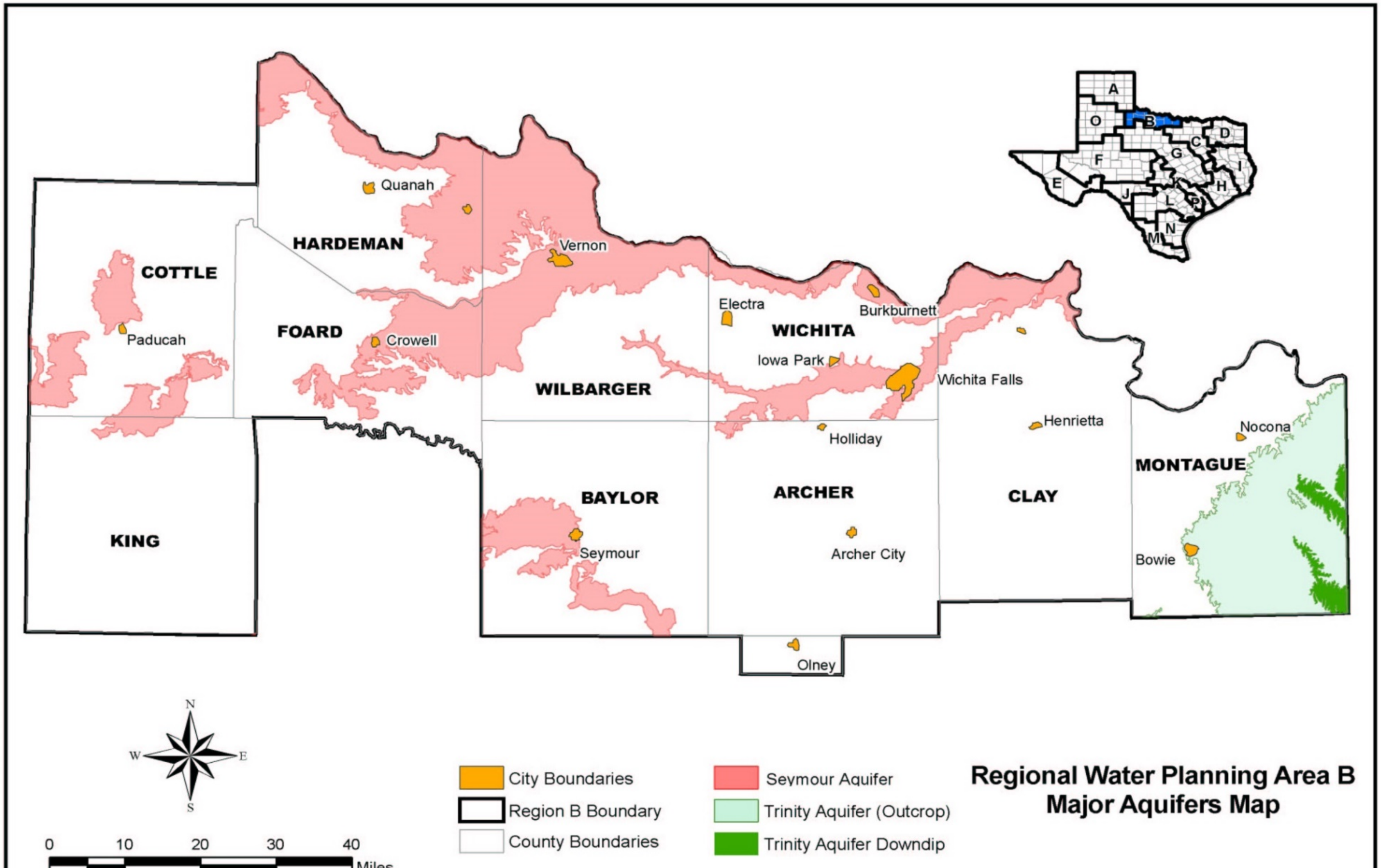
Extreme northern reaches of one of the state's most expansive aquifers, the Trinity Aquifer, lies in southeastern Montague County, the easternmost county in Region B. Water from this area of the aquifer is used for irrigation and domestic water supply purposes. Figure 3 shows the location of the major aquifers within Region B.

Figure 4 shows the location of the two minor aquifers in Region B, known as the Blaine Aquifer and the Cross Timbers Aquifer. The Blaine Aquifer is found only in Cottle, Foard, Hardeman, Knox, and King Counties of Region B, and the large majority of the water pumped from this aquifer is used for agricultural purposes. The water pumped from this aquifer is high in dissolved solids from natural halite dissolution. In addition to the natural contamination, significant pollutants are also present in the aquifer as a result of human activities such as oil and gas production and agriculture. The Cross Timbers (formerly known as the Paleozoic Aquifer) is found in portions of Wilbarger, Baylor, Wichita , Archer, Clay and Montague Counties and was recently designated a minor aquifer by TWDB. This formation has considerable extent through Region B, but production is limited and TWDB has not developed a groundwater availability model for the Cross Timbers.

At one time, nearly 150 natural springs and seeps across the area were known to exist within Region B. While some continue to produce water today, many of these springs have dried up over time due to over-pumping of the groundwater for municipal, agriculture, industrial, and mining use. A few small producing springs feed natural ponds and creeks that are habitat for many plants and animals. It should be recognized that any future development of underground sources of water, as well as the overuse of existing surface water supplies, may cause a decline in the viability of existing springs.

Agriculture irrigation is the main component of regional water use, accounting for approximately 62 percent of all water used. Irrigation water is currently provided from Lakes Kemp and Diversion through a distribution system of canals and pipe by the Wichita County Water Improvement District, the major irrigation provider in the region. A significant amount of irrigation is also provided from groundwater. Irrigation use in the region is expected to remain constant throughout the planning period at approximately 96,498 acre-feet (ac-ft) per year as more efficient pumping and irrigation techniques are implemented across the region. Municipal use is expected to increase from approximately 33,380 ac-ft per year to 34,720 ac-ft per year due mainly to the increase in population. In addition, manufacturing water use is expected to increase from 2,427 to 2,635 ac-ft per year, however, mining water use is expected to decrease from 5,203 to 1,701 ac-ft per year. Finally, both steam electric power water use at 7,742 ac-ft per year and livestock water use at 11,239 ac-ft per year are expected to remain constant throughout the planning period.

The overall water use in the region is projected to decrease from approximately 156,489 ac-ft per year to 154,535 ac-ft per year throughout the planning period and Figure 5 shows the actual water use by category for Region B in the years 2010, 2020 and 2070. The 2020 and 2070 projections are taken from Chapter 2 of this report.


COTTLE
HARDEMAN
FOARD
WILBARGER
WICHITA
KING
BAYLOR
ARCHER
CLAY
MONTAGUE
Quanah
Vernon
Paducah
Crowell
Electra
Burkburnett
Iowa Park
Wichita Falls
Henrietta
Holliday
Nocona
Seymour
Archer City
Bowie
Olney
A
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W
0
10
20
30
40
Miles
City Boundaries
Region B Boundary
County Boundaries
Seymour Aquifer
Trinity Aquifer (Outcrop)
Trinity Aquifer Downdip
Regional Water Planning Area B
Major Aquifers Map

Figure 3

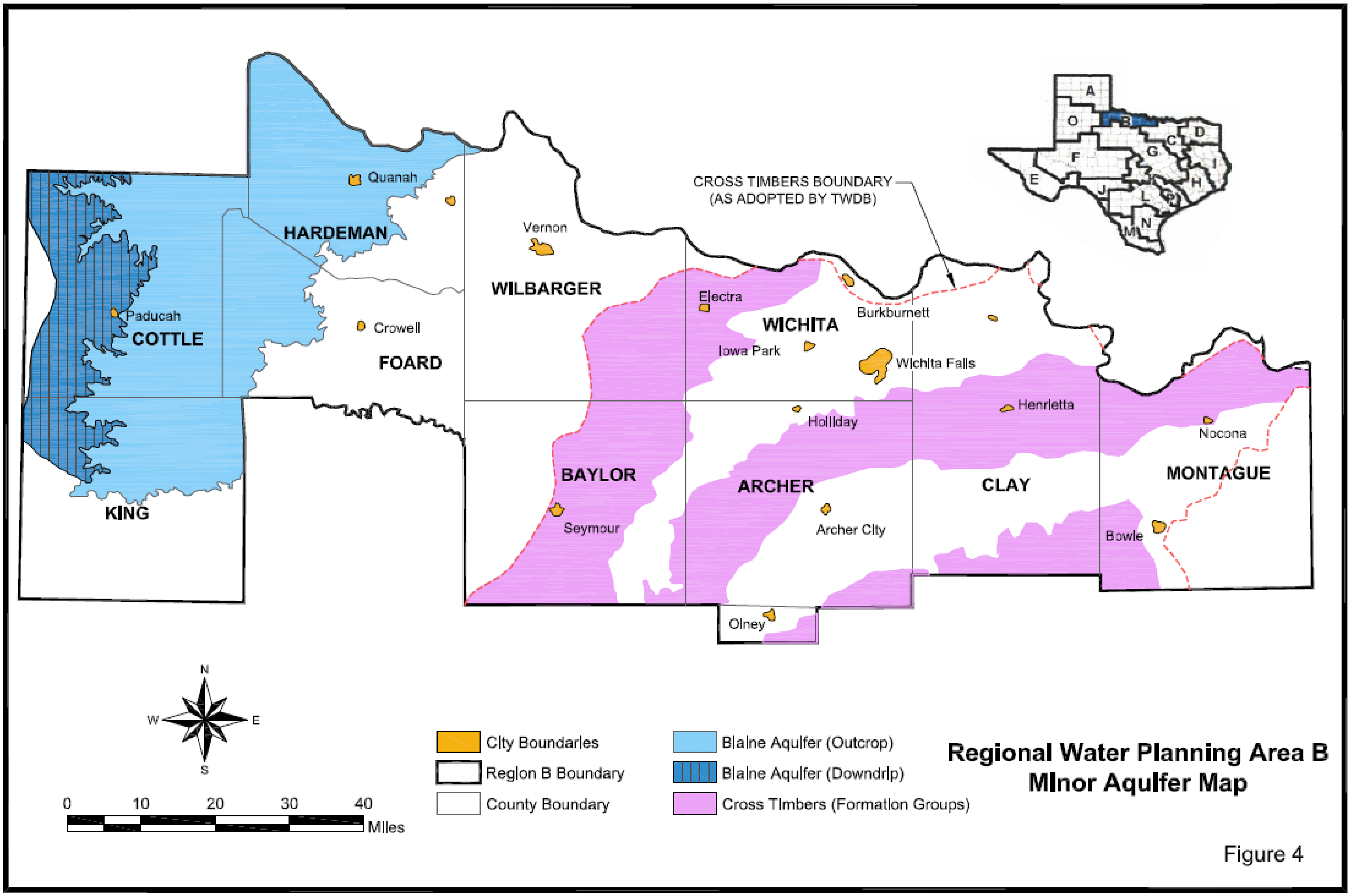
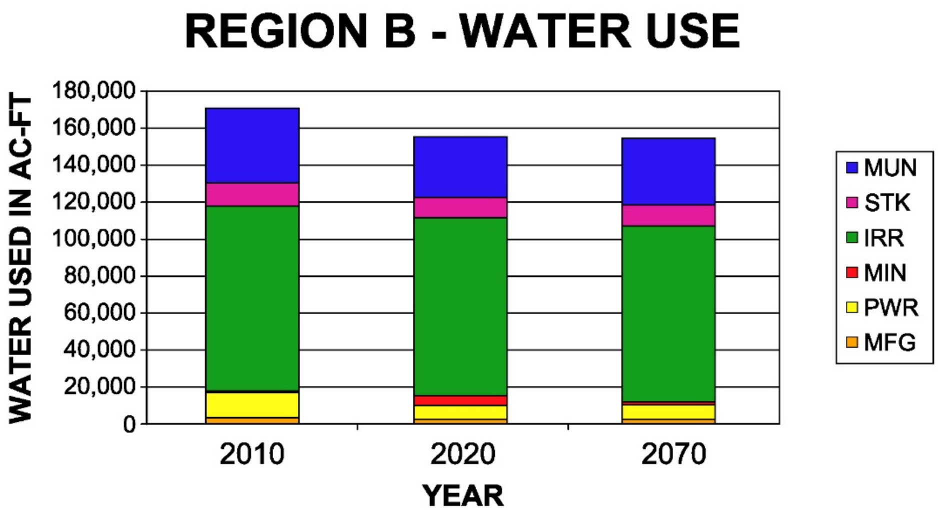

CROSS TIMBERS BOUNDARY
(AS ADOPTED BY TWDB)
HARDEMAN
Quanah
Vernon
WILBARGER
COTTLE
Paducah
Crowell
FOARD
Electra
WICHITA
Burkburnett
Iowa Park
Wichita Falls
Henrietta
Holliday
Nocona
MONTAGUE
BAYLOR
ARCHER
CLAY
KING
Seymour
Archer City
Bowie
Olney
N
S
E
W
0
10
20
30
40
Miles
City Boundaries
Region B Boundary
County Boundary
Blaine Aquifer (Outcrop)
Blaine Aquifer (Downdrip)
Cross Timbers (Formation Groups)
Regional Water Planning Area B
Minor Aquifer Map

Figure 4

Figure 5



YEAR	MFG	PWR	MIN	IRR	STK	MUN	TOTAL
2010	3,547	13,360	909	99,895	12,489	40,964	171,164
2020	2,427	7,742	5,203	96,498	11,239	33,380	156,489
2070	2,635	7,742	1,702	96,498	11,239	34,720	154,535

Table 1-8 shows the water rights holders of Region B and their permitted and actual usage.

Table 1-8:
Surface Water Rights Holders and Their Usage

Rights Holder	Water Supply	Permitted Use (ac-ft)	Reported Use			
			2011	2012	2013	2014
A.L. Rhodes	Little Wichita River	3,600	1,555	0	0	0
City of Bowie	Amon G. Carter	5,000	1,084	1,043	902	775
N. Montague Co. MWA	Lake Nocona	1,260	0	0	535	454
Red River Authority	South Wichita River	8,780	595	524	320	333
Lonnie D. Allsup	Trib. Of Wichita River	2,150	0	0	0	0
City of Wichita Falls	Lake Wichita	7,961	0	0	0	0
Wichita County WID #2	Ls. Kemp & Diversion	193,000	83,342	0	0	0
W.T. Waggoner Estate	Ls. Santa Rosa & Wharton	3,070	655	250	53	235
City of Electra	Lake Electra	1,400	0	0	0	0
City of Wichita Falls	Lake Kickapoo	40,000	4,530	2,865	3,160	4,996
City of Olney	Ls. Olney & Cooper	1,260	579	367	127	0
City of Wichita Falls	Lake Arrowhead	45,000	19,778	18,613	11,924	7,079
City of Wichita Falls	Little Wichita River	2,352	0	0	0	0
City of Henrietta	Little Wichita River	1,560	538	491	411	318

A more detailed analysis of water use and water use projections is presented in Chapters 2 and 3 of this report.

1.5 Climate Data

The best way to describe the weather of Region B is volatile. It has the ability to change from one extreme to another in a short period of time. Annual precipitation can also vary greatly from year to year. The average annual rainfall for the region is 27.4 inches; however, the extremes range from 47 inches in 1915 to 13 inches in 2011. Table 1-9 shows monthly averages and records for the Wichita Falls area and Table 1-10 lists temperatures and rainfall for each county in the region.

Table 1-9:
Monthly Averages and Records for Wichita Falls

Monthly Avg's	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High Temp.	54	58	67	76	84	91	97	97	88	77	65	55
Low Temp.	30	34	41	49	60	68	72	71	63	52	40	31
Precipitation	1.14	1.75	2.20	2,61	3.92	4.15	1.59	2.50	2.81	3.11	1.65	1.62
Monthly Rec's	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
High Temp.	87	93	100	103	110	117	114	113	111	102	89	86
Low Temp.	-12	-8	6	24	35	50	54	53	38	21	14	-8
Snowfall	9.8	9.0	9.7	1.0	0.0	0.0	0.0	0.0	0.0	1.0	6.3	7.8
Rainfall	2.25	2.97	3.60	5.20	5.12	5.36	3.10	4.52	6.19	4.34	3.15	3.12

Table 1-10:
Temperature Extremes and Average Rainfall

	Temperature (F°)		Annual
	Jan. Mean Min.	July Mean Max.	Rainfall (in)
Archer	27	98	29
Baylor	28	97	28
Clay	27	95	32
Cottle	26	97	24
Young	27	97	31
Foard	24	97	26
Hardeman	24	97	27
King	24	97	25
Montague	28	95	34
Wichita	29	97	29
Wilbarger	26	97	28

The region is obviously drier in the western areas and has more rainfall in eastern and southern counties.

Since 1930, the entire state has experienced 8 major droughts. Three of these droughts have occurred in the past 18 years, in 2002, 2006 and 2010, and Region B was significantly impacted by the drought during 2010 – 2015. Based on generally accepted drought indicators, over 95 percent of Region B, experienced “Exceptional Drought” conditions from late in July 2011 through early October 2011 with about 25 percent of the region being in an “Extreme” or “Exceptional” drought conditions continuously from July 2011 through May 2015. A new drought of record was established for the Region B area during the period of July 2011 through May 2015.

Water providers, including wholesale water providers and larger retail municipalities in Region B have taken steps to prepare for and respond adequately to drought conditions through the preparation of individual Drought Contingency Plans (DCP) and by taking the necessary steps to implement those prepared plans, which require specified quantifiable targets for water use reductions and a means and method for plan enforcement.

1.6 Economic Aspects of Region B

The 3 main components of the region’s economy are farming, ranching, and mineral production. The Texas Railroad Commission reports that Region B has approximately 14,954 regular producing oil wells and 1,283 regular producing gas wells. Table 1-11 provides a tabulation by county of the current oil and gas wells, as of February, 2019.

Table 1-11:
Number of Oil and Gas Wells

County	Oil Wells	Gas Wells
Archer	2,818	3
Baylor	134	0
Clay	1,116	19
Cottle	43	79
Foard	72	131
Hardeman	214	0
King	458	25
Montague	2,197	822
Wichita	4,769	0
Wilbarger	941	0
Young	2,192	204
Total	14,954	1,283

The service infrastructure is also strong. Some of the services offered throughout Region B include agribusiness, oilfield service, grain, fiber, and food processing. Wichita County, the most populous county in the region, is the retail trade center for a large area. Sheppard Air Force Base and medical services also are big contributors to the economy of Wichita County. The region boasts a variety of manufacturing. Some areas of manufacturing include oilfield equipment, clothing, building products, plastics, electronics, wood products, and aircraft equipment.

1.7 Land Use

Region B includes some of the largest ranches in the state, including the Waggoner Ranch in Wilbarger County and the Four Sixes Ranch in King County. It has over 1 million acres of croplands and over 3 million acres of open range. Table 1-12 shows land use percentages for each county in the region. Percentages under the heading of "Conservation" represent lands that had previously been croplands, but have been converted to the Conservation Reserve Program. The Conservation Reserve Program, or CRP, subsidizes farmers and landowners to convert highly erodible farmland to permanent grassland for a period of ten years.

Table 1-12:
Percentage of Land Use by County

County	Crops	Federal	Conservation	Pasture	Range	Urban	Water	Transportation
Archer	21.4%	<0.1%	0.3%	1.1%	73.1%	0.9%	2.1%	1.1%
Baylor	27.1%	-	0.1%	0.1%	71.9%	0.2%	0.3%	0.3%
Clay	15.7%	-	0.6%	3.0%	77.5%	1.6%	1.1%	0.5%
Cottle	17.4%	-	0.1%	0.4%	81.0%	0.3%	0.2%	0.6%
Foard	26.7%	-	2.5%	-	69.9%	-	0.6%	0.3%
Hardeman	36.9%	-	1.5%	0.4%	59.0%	0.8%	0.9%	0.5%
King	9.7%	-	2.3%	0.4%	86.4%	0.0%	0.6%	0.6%
Montague	15.1%	n/a	n/a	n/a	67.8%	n/a	n/a	n/a
Wichita	31.9%	0.8%	1.0%	1.3%	60.0%	2.3%	1.5%	1.2%
Wilbarger	33.5%	-	0.2%	1.1%	64.3%	<0.1%	0.1%	0.7%
Young	18.7%	-	1.1%	1.5%	74.2%	1.6%	1.6%	1.3%

Typical crops in Region B include cotton, coastal bermuda, wheat, alfalfa, peanuts, grain sorghum, watermelons, pecans, peaches, and other various fruits. Cattle for beef and dairy production is the major component of the livestock industry, with sheep, swine, and equine also present.

1.8 Navigable Waterways

Navigable waters of the United States are those waters that are subject to the ebb and flow of the tide and/or presently being used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. Based on information from the U.S. Army Corps of Engineers, there are no navigable waters within Region B.

1.9 Ecology and Wildlife

Most of Region B lies in the area known as the “Rolling Plains” with the exception of Montague County, which lies in the "Oakwoods and Prairies" area. The Texas Parks and Wildlife Department describes the “Rolling Plains” region as a “gently rolling plain of mesquite and short grass savanna.” The open range is generally characterized by its mesquite brush, prairie grasses, and sandstone outcroppings and cottonwood, hackberry, and saltcedar brush can be found near most rivers and streams. This vegetation is important to the survival of both resident and migratory birds. It is evident by the widespread mesquite, however, that over-grazing, soil erosion, and the lowering of the groundwater table have all contributed to the decline of the native grasslands. The topography of the region gently slopes to the east and southeast. The Red River and its major tributaries drain most of the region; however, extreme southern reaches of the region are drained by tributaries of the Brazos and Trinity Rivers.

The Texas Parks and Wildlife Department uses freshwater mussels as water quality indicators because they are usually the first organisms to show their sensitivity to changes in aquatic quality. Recent surveys have determined that 52 separate species of mussels have declined[1]. Another organism used to indicate water quality is the minnow. Since 1950, minnows native to the Big Wichita River System have also shown serious declines. These native minnows include the plains minnow, the silver chub, and several varieties of shiner. The plains minnow is commonly used in support of a significant commercial baitfish industry. The decline of these organisms indicates poor water conservation and management. Runoff and scouring flows have increased with broad increases in over-grazing, highway development, and general land clearing. Scouring flows can cause excessive sedimentation, thus eliminating the natural habitats of these organisms.

The “Rolling Plains” region of Texas is not usually thought of as an area rich in wetland habitats. However, the region is actually very important to both migrating and wintering waterfowl. In fact many species of migrating shorebirds, raptors, and other birds stop over in the region to feed and rest on the available wetlands.

There are over 40 species of water-dependent reptiles, amphibians, and mammals that live in the study area. Some of these include minks, muskrats, beavers, snakes, turtles, salamanders, and frogs. Fish species present in the study area include drum, carp, buffalo, bluegill, sunfish, largemouth and white bass; white crappie; flathead, blue, and channel catfish. Some endangered species are also present across the region. Table 1-13 lists the endangered and threatened species present in the region.

Copper Breaks State Park located 12 miles south of Quanah in Hardeman County contains 1,889 acres, and a 70 acre lake. The park has abundant wildlife and is home for part of the official Texas Longhorn herd.

Table 1-13:
Region B - Endangered/Threatened Species

SPECIES	STATE STATUS	FEDERAL STATUS
Bald Eagle	Threatened	-
American Peregrine Falcon	Threatened	-
Peregrine Falcon	Threatened	-
Whooping Crane	Endangered	Endangered
Golden-Cheeked Warbler	Endangered	Endangered
White-Faced Ibis	Threatened	-
Interior least tern	Endangered	Endangered
Black-capped Vireo	Endangered	Endangered
Texas Fawnsfoot	Threatened	-
Texas Kangaroo Rat	Threatened	-
Black-footed Ferret	-	Endangered
Brazos Water Snake	Threatened	-
Texas Horned Lizard	Threatened	-
Piping Plover	-	Threatened
Gray Wolf	Endangered	Endangered
Red Wolf	Endangered	Endangered
Timber Rattlesnake	Threatened	-
Lesser Prairie Chicken	-	Threatened
Small Eye Shiner	Threatened	Endangered
Sharp Nose Shiner	Threatened	Endangered
Brazos Heelsplitter	Threatened	-
Black Rail	Threatened	Proposed Threatened
Chub Shiner	Threatened	-
Prairie Chub	Threatened	-
Red River Pup Fish	Threatened	-

1.10 Summary of Existing Local or Regional Water Plans

In April, 2009 a Water Conservation Implementation Plan was prepared for Wichita County Water Improvement District No. 2. This plan will be used to meet the irrigation needs in the region by replacing/enclosing selected portions of the canal laterals that have the largest quantities of water loss.

In addition, information was gathered from water providers of Region B to determine, among other things, if they possessed a water conservation plan or a local or regional water plan. Table 1-14 lists the results of those surveys and inquiries.

Table 1-14:
Survey Results Regarding Water Plans
(Municipal Providers)

Water Provider	Existing Drought Contingency Plan?	Existing Water Conservation Plan?	Existing Local or Regional Water Plan?	Special Concerns of the Provider
Archer County MUD	Y	Y	N	Supply
Arrowhead Lake Water System	Y	Y	N	
Arrowhead Ranch Estates Water System	Y	Y	N	
Baylor County WSC	Y	Y	N	Nitrates
Box Community Water System	Y	Y	N	
City of Archer City	Y	Y	N	
City of Bowie	Y	Y	N	
City of Burkburnett	Y	Y	N	Nitrates
City of Byers	N	N	N	Nitrates
City of Charlie	N	N	N	Nitrates
City of Crowell	Y	N	N	Nitrates
City of Dumont	N	N	N	
City of Electra	Y	Y	N	Nitrates
City of Henrietta	Y	Y	Y	
City of Holliday	Y	Y	N	
City of Iowa Park	Y	Y	N	
City of Lakeside City	Y	Y	N	Storage
City of Megargel	Y	N	N	
City of Nocona	Y	Y	N	
Nocona Hills WSC	Y	Y	Y	Nitrates
City of Olney	Y	Y	N	Storage
City of Paducah	N	N	N	
City of Petrolia	N	N	N	
City of Pleasant Valley	N	N	N	
City of Quanah	N	N	N	
City of Saint Jo	Y	Y	N	
City of Scotland	Y	N	N	
City of Seymour	Y	N	N	Nitrates
City of Sunset	N	N	N	Storage
City of Vernon	Y	Y	Y	Nitrates
City of Wichita Falls	Y	Y	Y	
Dean Dale WSC	Y	Y	N	
Farmers Valley Water System	Y	Y	N	
Foard County Water System	Y	Y	N	
Forestburg WSC	N	N	N	
Goodlett Water System	Y	Y	N	
Hinds Water System	Y	Y	N	
Horseshoe Bend WSC	N	N	N	
Lockett Water System	Y	Y	N	
Medicine Mound Water System	Y	Y	N	
Northside WSC	Y	Y	Y	Nitrates
Quanah NE Water System	Y	Y	N	
Ringgold Water System	Y	Y	N	
South Quanah Water System	Y	Y	N	
Wichita Valley WSC	Y	Y	N	
Windthorst WSC	Y	Y	N	

1.11 Summary of Recommendations

It is anticipated that with the implementation of the recommended Water Management Strategies, Region B will have adequate water supplies throughout the planning period. The main recommendations of the Plan are to implement wastewater reuse projects, pursue a permit to construct Lake Ringgold, and to employ conservation measures to reduce water waste. Also, the heavy dissolved solid and chloride concentrations in the western portions of the region are preventing the full utilization of the available water resources. To reduce this, it is recommended that the Red River Chloride Control Project, sponsored by the Red River Authority of Texas, continue to be funded and operated.

1.12 Identification of Known Threats to Agriculture or Natural Resources

Excessive concentrations of total dissolved solids, sulfate, and chloride are a general problem in most streams of the Red River Basin under low flow conditions. The high salt concentrations are caused, in large part, by the presence of salt water springs, seeps, and gypsum outcrops. Salt water springs are generally located in the western portion of the (Red River) basin in the upper reaches of the Wichita River, the North and South Forks of the Pease River, and the Little Red, which is a tributary to the Prairie Dog Town Fork of the Red River. Gypsum outcrops are found in the area ranging westward from Wichita County to the High Plains Caprock Escarpment.

The excessive amounts of dissolved solids and chlorides in the water present problems to managers, planners, and others concerned with water treatment for municipal use. For this reason, the quality of the available water supply is as much an issue as the quantity for Region B. Water consumers of all kinds, whether municipal, industrial, or agricultural, desire water that is less saline; however, these conditions have existed for many years, and the plants and animals that live with them have adapted well. The Red River Authority of Texas is sponsoring a federal chloride control project to control the natural chloride level in the Red River Basin by impounding high chloride waters from the natural brine springs.

In addition, there are areas in Region B with highly erodible soils that contribute to an accumulation of sediment in the lakes and reservoirs. This sediment over time, can significantly reduce storage capacity and reliable water supplies.

There is limited recent information available with regards to groundwater levels and drawdown data within the region. However, historical use indicates that with the exception of Wilbarger County, much of the groundwater is not fully developed or not currently being used. Therefore, it is anticipated that additional groundwater can be developed to meet the projected water demands through the planning period with no known threats to Agriculture or Natural Resources.

1.13 Water Providers in Region B

Water is provided in Region B by a number of entities. The cities provide most of the municipal and manufacturing water in the region with the City of Wichita Falls providing the majority of the water. Other large providers include the Red River Authority of Texas and the Greenbelt Water Authority. The following Table 1-15 shows a comprehensive listing of the water providers and the municipal water demands for the projected years 2020 through 2070. A more detailed discussion of water use is presented in Chapter 2 of this report. It should be noted that these use figures do not include water for irrigation, manufacturing, electrical power, livestock, or mining.

Table 1-15:

Water Providers and Users in Region B

Utility ID	RWPG	County	WUG Name	Municipal Demands 2020	Municipal Demands 2030	Municipal Demands 2040	Municipal Demands 2050	Municipal Demands 2060	Municipal Demands 2070
93	B	ARCHER	ARCHER CITY	263	255	248	244	244	244
94	B	ARCHER	ARCHER COUNTY MUD 1	147	144	143	141	141	141
167	B	ARCHER	BAYLOR SUD	33	33	33	33	33	33
	B	ARCHER	COUNTY-OTHER, ARCHER	133	114	108	107	106	106
1280	B	ARCHER	HOLLIDAY	231	255	262	259	258	258
1520	B	ARCHER	LAKESIDE CITY	125	125	121	120	119	119
2439	B	ARCHER	SCOTLAND	194	242	240	239	239	239
3000	B	ARCHER	WICHITA VALLEY WSC	221	222	220	216	215	215
3032	B	ARCHER	WINDTHORST WSC	294	303	303	301	301	301
ARCHER COUNTY TOTAL				**1,641**	**1,693**	**1,678**	**1,660**	**1,656**	**1,656**
167	B	BAYLOR	BAYLOR SUD	197	196	194	195	195	196
	B	BAYLOR	COUNTY-OTHER, BAYLOR	16	13	12	11	11	10
2462	B	BAYLOR	SEYMOUR	490	476	465	464	463	463
BAYLOR COUNTY TOTAL				**703**	**685**	**671**	**670**	**669**	**669**
	B	CLAY	COUNTY-OTHER, CLAY	451	455	442	435	434	434
683	B	CLAY	DEAN DALE SUD	163	159	151	149	149	149
1223	B	CLAY	HENRIETTA	664	669	657	650	649	649
2271	B	CLAY	RED RIVER AUTHORITY OF TEXAS	379	372	366	365	364	364
3032	B	CLAY	WINDTHORST WSC	140	141	139	138	138	138
CLAY COUNTY TOTAL				**1,797**	**1,796**	**1,755**	**1,737**	**1,734**	**1,734**
	B	COTTLE	COUNTY-OTHER, COTTLE	42	41	40	40	40	40
2070	B	COTTLE	PADUCAH	290	283	282	281	281	281
2271	B	COTTLE	RED RIVER AUTHORITY OF TEXAS	12	12	12	12	12	12
COTTLE COUNTY TOTAL				**344**	**336**	**334**	**333**	**333**	**333**
	B	FOARD	COUNTY-OTHER, FOARD	7	8	8	8	8	8
623	B	FOARD	CROWELL	138	133	131	131	131	130
2271	B	FOARD	RED RIVER AUTHORITY OF TEXAS	89	87	86	86	86	86
FOARD COUNTY TOTAL				**234**	**228**	**225**	**225**	**225**	**224**
	B	HARDEMAN	COUNTY-OTHER, HARDEMAN	163	154	144	141	135	130
2226	B	HARDEMAN	QUANAH	396	391	387	394	397	400
2271	B	HARDEMAN	RED RIVER AUTHORITY OF TEXAS	129	141	151	163	175	186
HARDEMAN COUNTY TOTAL				**688**	**686**	**682**	**698**	**707**	**716**
	B	KING	COUNTY-OTHER, KING	22	25	25	25	25	25
2271	B	KING	RED RIVER AUTHORITY OF TEXAS	53	52	52	51	51	51
KING COUNTY TOTAL				**75**	**77**	**77**	**76**	**76**	**76**
279	B	MONTAGUE	BOWIE	995	1,003	997	1,002	1,011	1,019
	B	MONTAGUE	COUNTY-OTHER, MONTAGUE	1,164	1,162	1,144	1,144	1,150	1,156
1938	B	MONTAGUE	NOCONA	740	751	750	758	765	771
1939	B	MONTAGUE	NOCONA HILLS WSC	105	106	106	107	108	108
2271	B	MONTAGUE	RED RIVER AUTHORITY OF TEXAS	78	85	91	99	106	112
2396	B	MONTAGUE	SAINT JO	155	156	155	155	157	158
MONTAGUE COUNTY TOTAL				**3,237**	**3,263**	**3,243**	**3,265**	**3,297**	**3,324**
350	B	WICHITA	BURKBURNETT	1,461	1,460	1,457	1,462	1,483	1,505
	B	WICHITA	COUNTY-OTHER, WICHITA	33	61	84	99	114	127
683	B	WICHITA	DEAN DALE SUD	81	79	77	78	79	80
819	B	WICHITA	ELECTRA	884	902	916	932	947	961
1202	B	WICHITA	HARROLD WSC	12	13	13	13	13	14
1331	B	WICHITA	IOWA PARK	884	884	882	885	898	911
2487	B	WICHITA	SHEPPARD AIR FORCE BASE	979	951	929	919	917	917
2999	B	WICHITA	WICHITA FALLS	16,873	16,987	17,055	17,159	17,422	17,677
3000	B	WICHITA	WICHITA VALLEY WSC	370	369	368	368	373	379
WICHITA COUNTY TOTAL				**21,577**	**21,706**	**21,781**	**21,915**	**22,246**	**22,571**
	B	WILBARGER	COUNTY-OTHER, WILBARGER	210	204	196	192	185	176
1202	B	WILBARGER	HARROLD WSC	94	97	98	101	102	104
2271	B	WILBARGER	RED RIVER AUTHORITY OF TEXAS	258	282	304	328	351	374
2867	B	WILBARGER	VERNON	1,882	1,922	1,933	1,981	2,018	2,048
WILBARGER COUNTY TOTAL				**2,444**	**2,505**	**2,531**	**2,602**	**2,656**	**2,702**
167	B	YOUNG	BAYLOR SUD	43	43	42	42	43	43
	B	YOUNG	COUNTY-OTHER, YOUNG	41	51	58	66	74	82
2045	B	YOUNG	OLNEY	556	558	558	566	577	590
YOUNG COUNTY TOTAL				**640**	**652**	**658**	**674**	**694**	**715**
REGION B TOTALS				**33,380**	**33,627**	**33,635**	**33,855**	**34,293**	**34,720**

1.14 Major Water Providers

A Major Water Provider (MWP) is Water User Group (WUG) or Wholesale Water Provider (WWP) of particular significance to the region's water supply as determined by the Regional Water Planning Group (RWPG). A WWP is any person or entity including river authorities and irrigation districts, that delivers or sells water wholesale (treated or raw) to WUGs or other WWPs.

The only two (2) RWPG designated "Major Water Providers" in Region B are the City of Wichita Falls and Wichita County Water Improvement District No. 2.

Tables 1-16 and 1-17 list the Wholesale Water Demands and other additional information for the City of Wichita Falls and Wichita County Water Improvement District No. 2.

Table 1-16:

Wholesale Water Demands for Wichita Falls Water System

CUSTOMERS	CONTRACT		Demands (Acre-Feet per Year)					
	(MGD)	(AF/Yr)	2020	2030	2040	2050	2060	2070
Wichita Falls	No contract amt use 20% increase of demands		20,248	20,384	20,466	20,591	20,906	21,212
Archer City	0.6	336	336	336	336	336	336	336
Archer Co. Mud #1	0.15	84	84	84	84	84	84	84
Holliday	No contract amt use 20% increase of demands		277	306	314	311	310	310
Lakeside City	0.16	179	179	179	179	179	179	179
Scotland	0.18	202	202	202	202	202	202	202
Windthorst WSC	0.75	420	420	420	420	420	420	420
Dean Dale WSC (Clay County)	0.825	462	309	309	306	303	302	301
Red River Auth. (Clay County)	0.37	415	415	415	415	415	415	415
Red River Auth. (Lake Arrowhead)			see above					
Texas Parks & Wildlife (Lake Arrowhead)			see above					
Burkburnett	1.67	1,872	1,872	1,872	1,872	1,872	1,872	1,872
Dean Dale WSC (Wichita County)			153	153	156	159	160	161
Friberg Cooper WSC	0.15	168	168	168	168	168	168	168
Iowa Park	2.5	1,401	1,401	1,401	1,401	1,401	1,401	1,401
Electra	1.5	841	841	841	841	841	841	841
Wichita Valley WSC	1.205	675	675	675	675	675	675	675
Pleasant Valley	0.1	112	112	112	112	112	112	112
Sheppard A.F.B.	No contract amt use 20% increase of demands		1,175	1,141	1,115	1,103	1,100	1,100
Wichita Valley WSC	1.01	1132	1,132	1,132	1,132	1,132	1,132	1,132
Olney	1	561	561	561	561	561	561	561
Manufacturing	No contract amt. assume 60% of Wichita County Demands		738	792	792	792	792	792
Steam Electric		360	31	31	31	31	31	31
Total Demand			31,329	31,515	31,579	31,688	32,000	32,306

Table 1-17:

Wholesale Water Demands for WCWID#2 System

CUSTOMERS	CONTRACT (AF/Yr)	Demands (Acre-Feet per Year)					
		2020	2030	2040	2050	2060	2070
Archer County Irrigation		1,251	1,251	1,251	1,251	1,251	1,251
Clay County Irrigation		100	100	100	100	100	100
Wichita County Irrigation		38,256	38,256	38,256	38,256	38,256	38,256
Wilbarger Stream Electric	20,000	7,711	7,711	7,711	7,711	7,711	7,711
TPWD Dundee Fish Hatchery		2,200	2,200	2,200	2,200	2,200	2,200
TOTAL		49,518	49,518	49,518	49,518	49,518	49,518

1.15 Water Loss Audits

Since 2003, retail public water utilities have been required to complete and submit a water loss audit form to the TWDB every five years, with the primary purpose being to account for all of the water being used and to identify potential areas where water can be saved. Real water loss is water loss that is physically lost from the system before it can be used, including main breaks and leaks, customer service line breaks and leaks and storage overflows. Eight (8) water providers in Region B have submitted water loss audits since 2012, and based on these reports, the six-year average (2012-2017) percentage of the real water loss for the region is approximately 15 percent.

LIST OF REFERENCES

Evaluation of Selected Natural Resources in Parts of the Rolling Plains Region of North-Central Texas. Water Resources Team, Resource Protection Division, Texas Parks and Wildlife Department, 1998, http://www.tpwd.state.tx.us/texaswater/sb1/wildlife/rolling/summary.phtml.

County and City Data Books, Geospatial and Statistical Data Center, The University of Virginia, 2003, http://fisher.lib.Virginia.EDU/cgi-local/ccdb/countysortz.cgi.

DP-3. Profile of Selected Economic Characteristics: 2000, American Fact Finder, U.S. Census Bureau, http://factfinder.census.gov.

Monthly/Annual Streamflow Statistics for Texas, USGS Surface Water Data for Texas, Department of the Interior, U.S. Geological Survey, http://nwis.waterdata.usgs.gov/tx/nwis/sw.

Climatological Averages and Records for Wichita Falls, Texas, National Weather Service Forecast Office, National Oceanic and Atmospheric Administration, November, 2004, http://www.srh.noaa.gov/oun/climate/records.php.

Oil Well Counts by County, Oil and Gas Division, Texas Railroad Commission, February 2014, http://www.rrc.state.tx.us/data/wells/wellcount/oilwellct_0909

Gas Well Counts by County, Oil and Gas Division, Texas Railroad Commission, February 2014, http://www.rrc.state.tx.us/data/wells/wellcount/gaswellct_0909

Brune, Gunnar M. Springs of Texas, "Volume I" Ft. Worth: Branch-Smith, Inc., 1981.

Texas Counties Annual Precipitation: http://www.texascounties.net/statistics/precipitation.htm

2012 Census of Agriculture-USDA NASS http:www.nass.usda.gov/publication/agCensus/2012

CHAPTER 2

POPULATION AND WATER DEMAND PROJECTIONS

2021 FINAL PLAN

REGION B

OCTOBER 2020

CHAPTER 2

POPULATION AND WATER DEMAND PROJECTIONS
2021 FINAL PLAN
REGION B

2.1 Region B Overview

Previous regional and state water plans were aligned with political boundaries, such as city limits, rather than water utility service areas. In accordance with Texas Water Development Board (TWDB) rule changes, Water User Group (WUG) planning is now defined as utility-based and the population projections and associated water demand projections will be for the utility service area boundaries as opposed to the political boundaries.

Municipal WUGs in the 2021 Plan are defined as:

- 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 above 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 (RWPG);
- Municipal and domestic water use, referred to as County-Other, not included in the above;

Region B has thirty-eight (38) WUGs throughout its eleven county area, and population projections along with the associated water demands were determined for each WUG by decade from 2020 through 2070 and the RWPG approved projections are provided in Appendix G.

Region B contains only one city larger than 100,000, which is Wichita Falls. The other communities are smaller and more rural in nature with incomes that are dependent on agriculture and, to a lesser extent, the oil industry. Consequently, the population for the region is projected to have only a moderate increase for the next fifty years from 206,307 people in 2020 to 228,973 in 2070, or 11 percent.

Municipal water demands, which includes residential and commercial water use, are projected to increase from 33,380 acre-feet per year (AF/YR) in 2020 to 34,700 AF/YR in 2070 or a 4% increase over the next fifty years. However, the per capita municipal water use is predicted to slightly decline over the fifty year planning period from 144 gallons per capita per day (gpcd) in 2020 to 135 gpcd in 2070.

Non-Municipal water demands including irrigation, manufacturing, power, mining, and livestock water use are projected to decrease from 123,109 AF/YR in 2020 to 119,815 AF/YR in 2070 or a 2.7 percent decrease over the next fifty years.

Therefore, the total combined water demand for Region B is projected to decrease by 1,974 AF/YR or 1.3 percent over the next fifty years.

2.2 Population Growth

TWDB prepared the population projections by decade for all municipal WUGs using projection trends based on the population projections in the 2017 State Water Plan (SWP) as reassembled by utility service area. These population projections were then reviewed evaluated and approved on August 16, 2017 by the RWPG for use in the 2021 plan, and the Region B projected total population growth is shown in Figure 2-1 and Table 2-1.

Figure 2-1 Projected Population for Region B

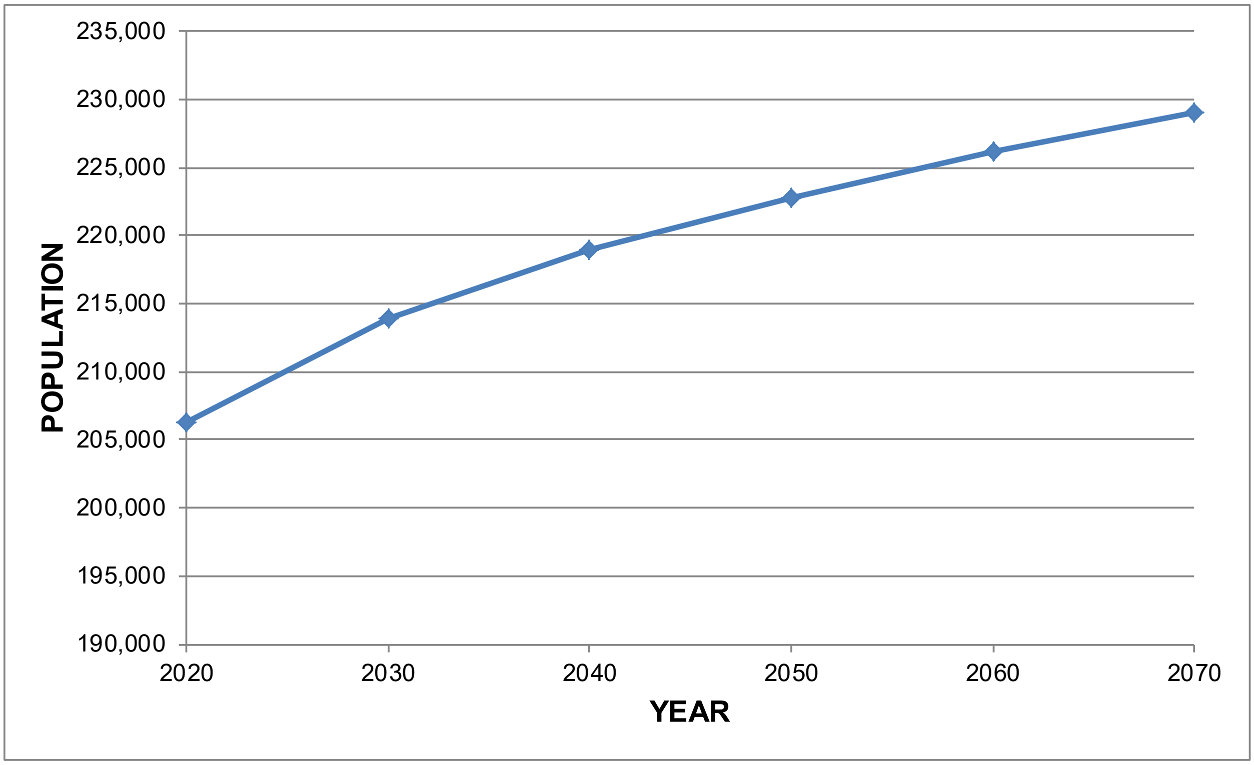


Table 2-1 Projected Population Data Points

YEAR	2020	2030	2040	2050	2060	2070
POPULATION	206,307	213,930	218,928	222,760	226,142	228,973

The city with the highest projected growth rate is Wichita Falls, and it is expected to grow by approximately 12 percent in the next fifty years. While agriculture and the oil and gas industry remain cornerstones of the regional economy, Wichita Falls has emerged as a regional hub for all forms of commerce ranging from the strong presence of manufacturing to regional health care services and regional retail centers. Other towns that may experience some growth include Bowie, Burkburnett, Electra, Iowa Park, and Vernon.

2.3 Water Uses

2.3.1 Total Region B Water Use

The water use for Region B has been divided into several categories for analysis purposes. The various uses analyzed include water for municipal use (MUN), industrial or manufacturing (MFG), power cooling (PWR), mining (MIN), agricultural irrigation (IRR), and livestock watering (STK).

Figure 2-2 shows the amounts of water predicted to be required for these categories through the year 2070. The water use is shown in AF/YR units with one acre-foot being equivalent to 325,850 gallons of water.

Figure 2-2 Projected Water Use for Region B

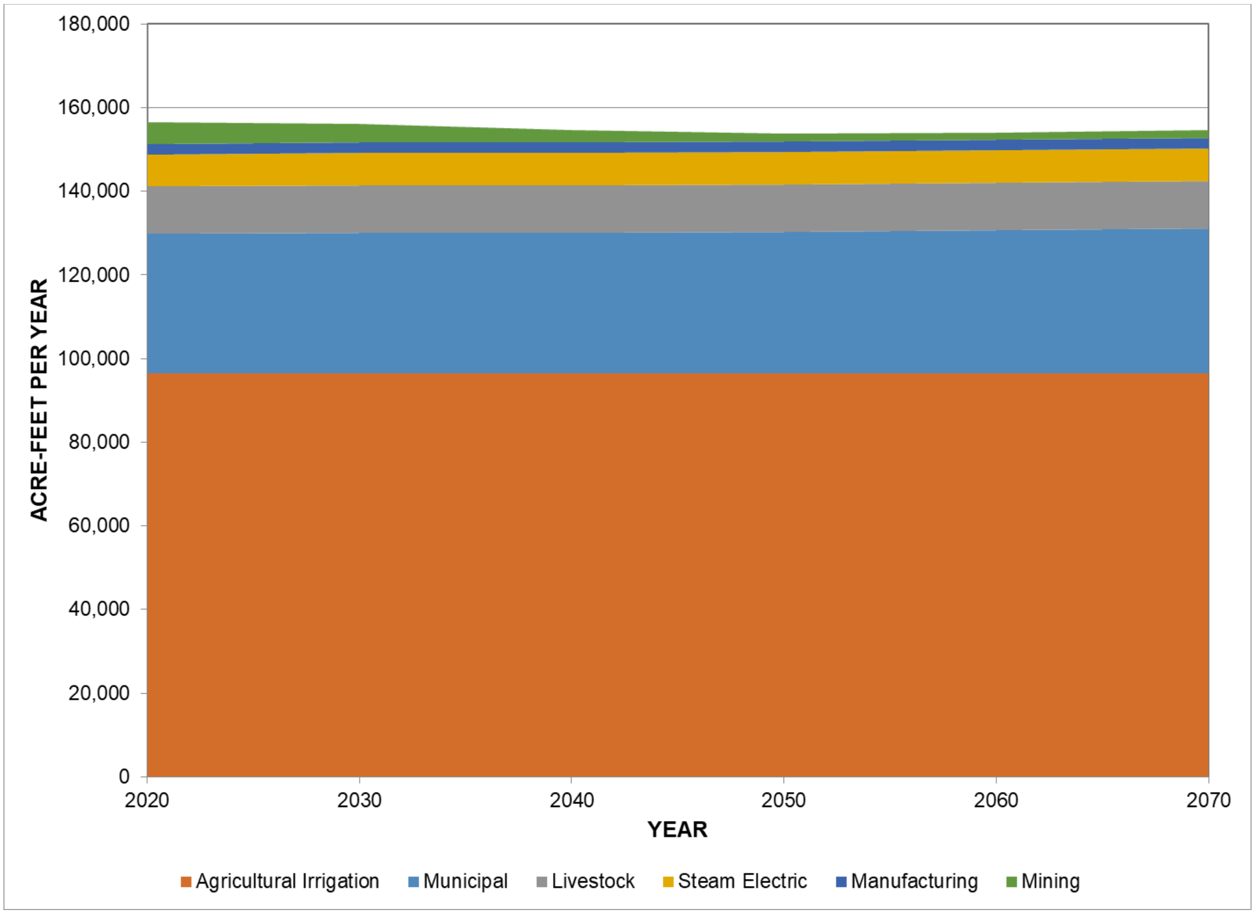


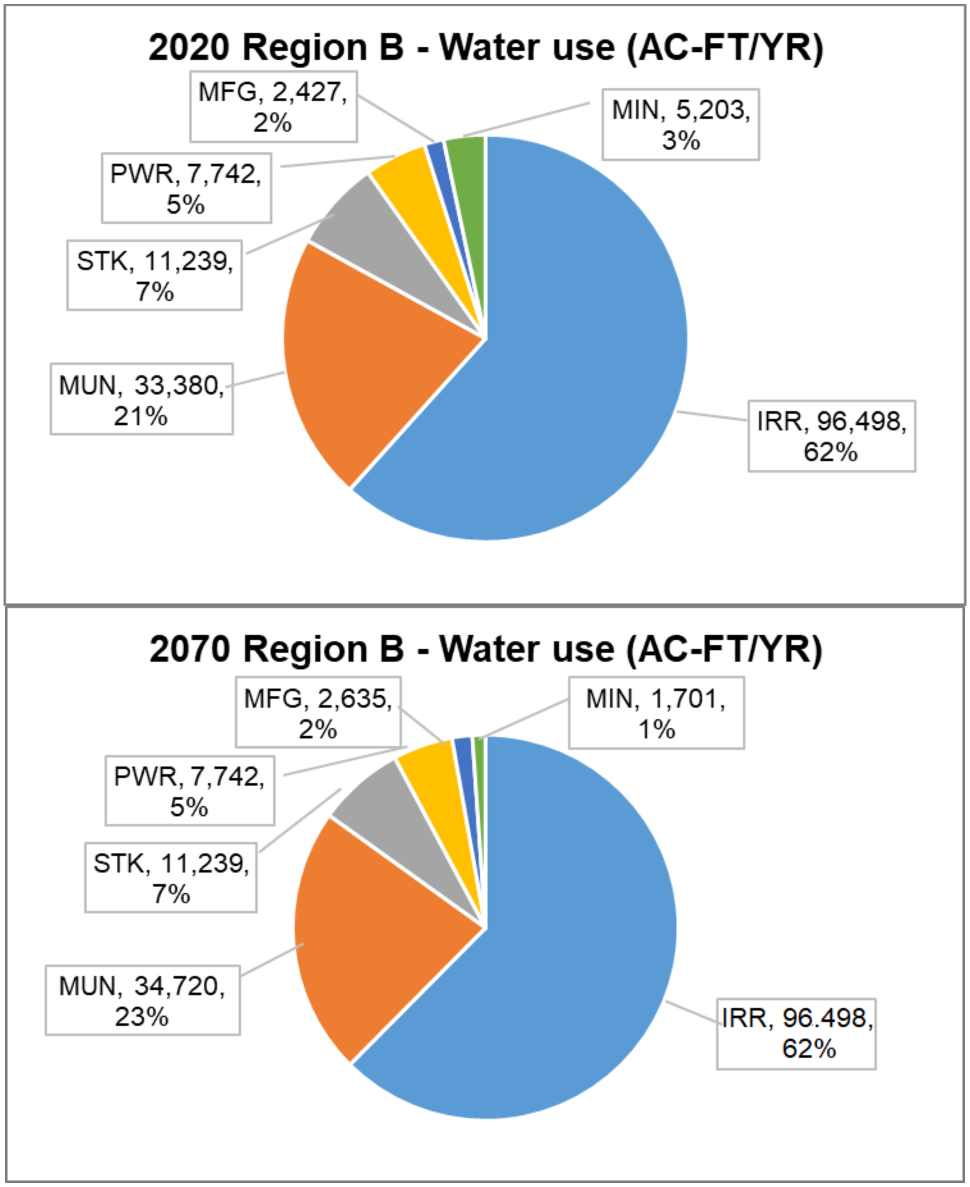
Table 2-2 Projected Water Use Data Points (Acre-Feet/Yr.)

YEAR	2020	2030	2040	2050	2060	2070
MFG	2,427	2,635	2,635	2,635	2,635	2,635
PWR	7,742	7,742	7,742	7,742	7,742	7,742
MIN	5,203	4,342	2,978	1,837	1,701	1,701
IRR	96,498	96,498	96,498	96,498	96,498	96,498
STK	11,239	11,239	11,239	11,239	11,239	11,239
MUN	33,380	33,627	33,635	33,855	34,293	34,720
TOTAL	156,489	156,083	154,727	153,806	154,108	154,535

Total water consumption for the region is predicted to remain approximately level from 2020 to 2070. Figure 2-3 compares the water uses of 2020 to the projected water uses for 2070.

The two scenarios in Figure 2-3 show that the composition of water use for this region is not anticipated to change much.

Figure 2-3 Composition of Projected Region B Water Use



2.3.2 Municipal Water Use

Municipal water use is defined by the TWDB as residential and commercial water use. Residential use includes single and multi-family household water use and commercial use includes water used by business establishments, public offices, and institutions, but does not include industrial water use. Residential and commercial water uses are categorized together because they are similar types of uses, for example, each category uses water primarily for drinking, cleaning, sanitation, cooling and landscape watering. Water use data are compiled for the water users of the region by the TWDB and the TCEQ.

The total municipal water use for Region B is shown to increase from 33,380 Ac-Ft in the year 2020 to 34,720 Ac-Ft in 2070, a demand increase of about 4 percent, which corresponds to a population increase of nearly 11 percent. The smaller percent increase in demand is anticipated because, as previously mentioned, the per capita water use is expected to decrease over the next fifty years. Decreases in per capita water use are expected due to water savings from more efficient plumbing fixtures as required by the State Plumbing Code.

2.3.3 Manufacturing Water Use

Manufacturing, or industrial, water use has been defined as water used in the production process of manufactured products, including water used by employees for drinking and sanitation purposes. Water use for manufacturing products (MFG) in Region B is a small percentage, approximately 2 percent, of the overall water use in this region.

The majority of the MFG water use is in Wichita County by the industrial facilities in and around Wichita Falls. Over 42 percent of the MFG water for the region is consumed in Wichita County. Hardeman and Wilbarger Counties also have facilities that require water in the MFG category, with Montague County having minimal demand in the MFG category. The top MFG facilities in Wichita County include: Arconic – gas turbines and engine components, Cryovac - Division of Sealed Air Corporation, Work Service Corporation – paper clips and wood products, Vitro – flat glass manufacturing, Ameron – fiberglass piping systems, and Tranter, Inc. – plate and frame heat exchangers. There are numerous other small industrial users in Region B.

Based on the increasing trend of water required for MFG in Region B, an increase from 2,427 Ac-Ft/Yr in 2020 to 2,635 Ac-Ft/Yr in 2070 has been projected, for an 8.6 percent increase in this category. Figure 2-4 shows the projections for manufacturing water use in Region B.

Region B will probably have some growth in the number of industrial facilities that locate in the area. The anticipated growth can be attributed to reasonable land prices, a good labor market, favorable business climate, and sufficient power supplies. While water resources have been a concern during the recent drought years, Wichita Falls has demonstrated leadership in developing short term solutions to sustain water supplies for existing and new industries.

Figure 2-4 Projected Industrial Water Use for Region B

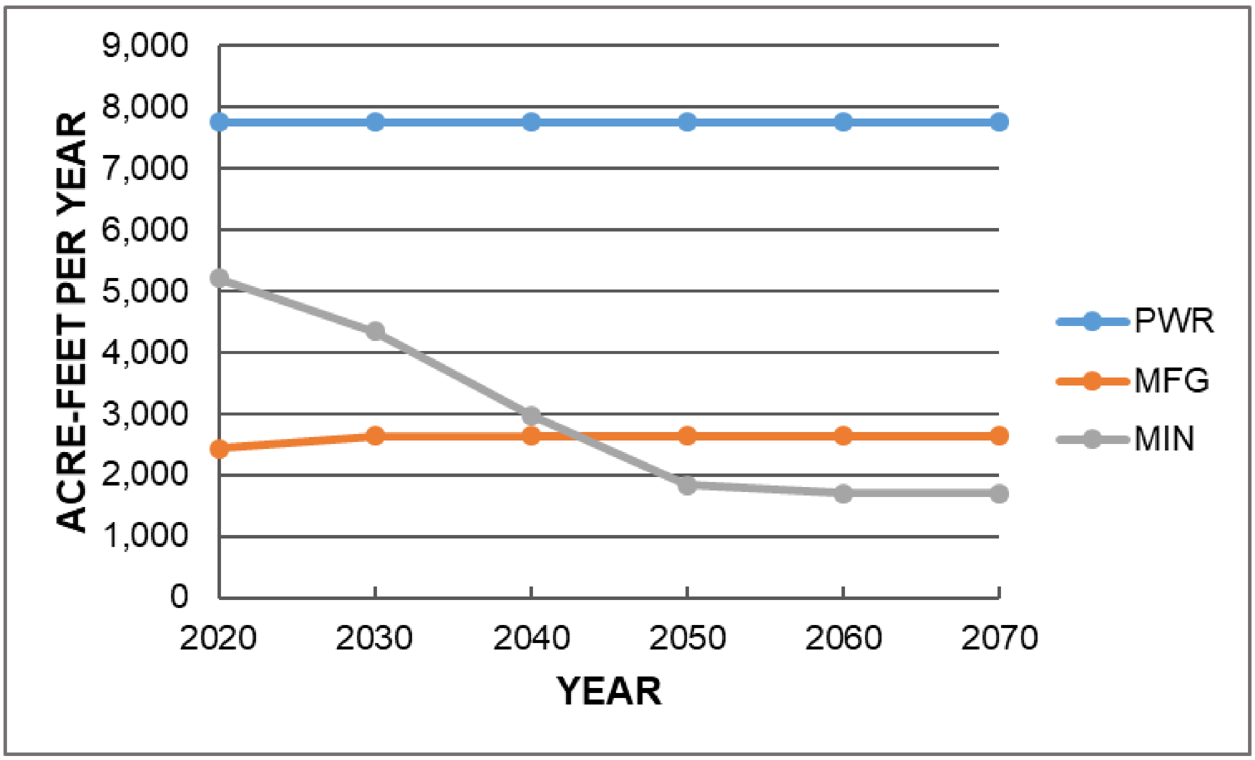


Table 2-3 Projected Industrial Water Use Data Points

YEAR	2020	2030	2040	2050	2060	2070
MFG	2,427	2,635	2,635	2,635	2,635	2,635
PWR	7,742	7,742	7,742	7,742	7,742	7,742
MIN	5,203	4,342	2,978	1,837	1,701	1,701

2.3.4 Steam-Electric Power Generation Water Use

The total demand for water for power generation decreased from 10,360 Ac-Ft/Yr in the last planning period to 7,742 Ac-Ft/Yr in the current planning period. The total water use required for steam-electric power generation for Region B is projected to remain at 7,742 Ac-Ft/Yr from 2020 through 2070. American Electric Power (AEP) has a power generating plant in Wilbarger County and AEP formerly owned a facility in Hardeman County. The Hardeman County Facility will not be returned to service and was removed from the water demands in the last planning period. The amount of water used for power generation in Region B will remain at 5 percent of the total demand through the planning period. The projections for water use for steam-electric power generation are also shown in Figure 2-4.

2.3.5 Mining Water Use

The oil and gas industry has played a large role in the history and development of the North Central Texas area and is primary "mining" activity in the region. Fresh water has been used in the past to drill wells and in some cases to water flood oil fields. The demand for water required for oil and gas drilling and production is expected to decline during the planning period. Based on current status of the oil industry and recent trends in water required for mining in this region, a decrease from 5,203 Ac-Ft/Yr required in 2020 to 1,701 Ac-Ft/yr in 2070 is projected and is shown in Figure 2-4.

2.3.6 Agricultural Irrigation Water Use

The largest water use in Region B is irrigated agriculture. Irrigated crops in the region include cotton, wheat, peanuts, alfalfa, hay-pasture, vegetables, orchards, and others. The total acreage irrigated varies from year to year depending on weather, crop price, government programs, and other factors. Agricultural irrigation use accounts for approximately 62 percent of the water use in 2020 and is projected to remain at 62 percent of all the water used in 2070. Figure 2-5 shows the projected agricultural irrigation water use.

A portion of the water used for irrigation in Region B is from groundwater, but the majority of the water used is surface water, which is delivered through unlined open canals and distribution laterals with some canals converted to pipelines to reduce water loss. The existing canal system is known to have significant water losses due to overflows out the end of many of the laterals. These water losses will remain in the total volume of water required for irrigation until the earthen laterals are converted to pipe.

Figure 2-5 Projected Agricultural Water Use for Region B

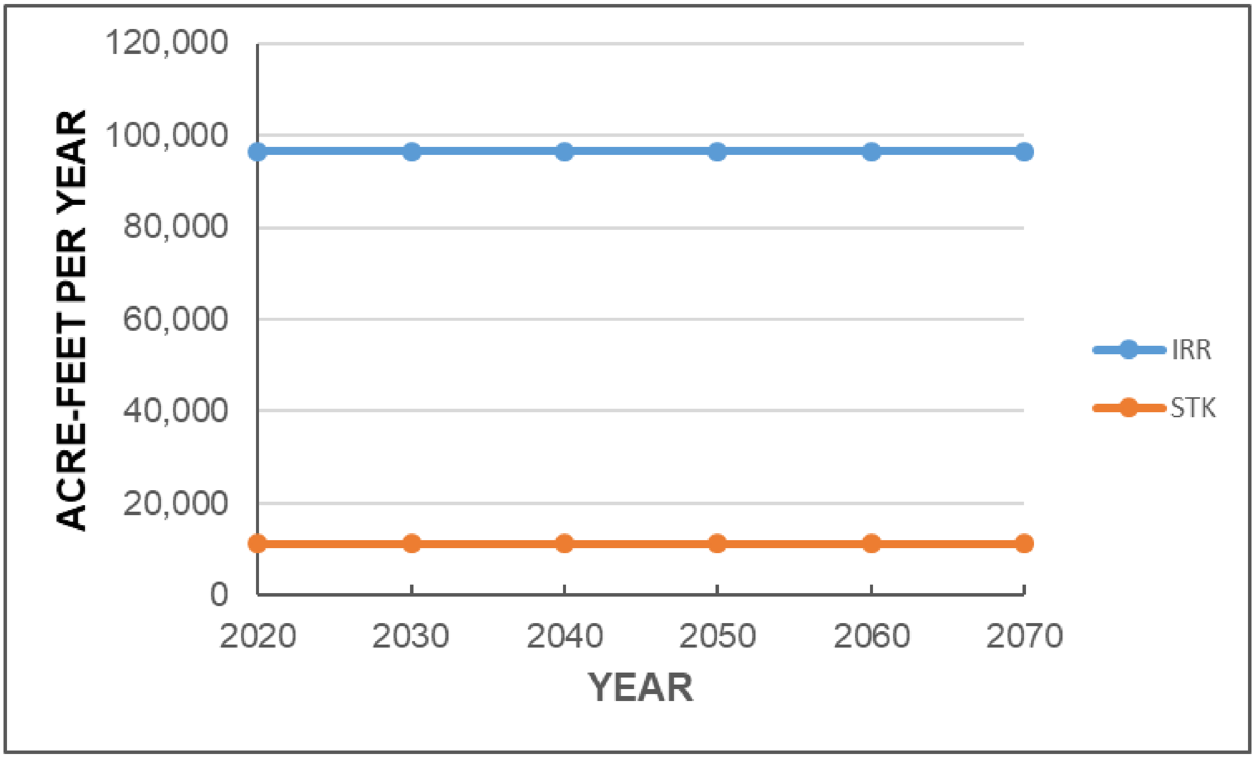


Table 2-4 Projected Agricultural Water Use Data Points

YEAR	2020	2030	2040	2050	2060	2070
IRR	96,498	96,498	96,498	96,498	96,498	96,498
STK	11,239	11,239	11,239	11,239	11,239	11,239

2.3.7 Livestock Water Use

Livestock production is an important part of the economy in Region B. In 2020, the total water used in the region for livestock is projected to be 11,239 Ac-Ft, and the use is projected to stay the same through 2070. The livestock water use projections are shown in Figure 2-5.

2.3.8 Major Water Providers

Two Major Water Provider (MWP) were identified by the Region B Water Planning Group. The MWPs in Region B are the City of Wichita Falls and Wichita County Water Improvement District Number 2 (WCWID#2). The wholesale water demands for the Wichita Falls water system are shown in Table 2-5, and the wholesale water demands for the WCWID#2 system are shown in Table 2-6.

Table 2-5 Wholesale Water Demands for the Wichita Falls Water System

CUSTOMERS	CONTRACT		Demands (Acre-Feet per Year)					
	(MGD)	(AF/Yr)	2020	2030	2040	2050	2060	2070
Wichita Falls	No contract amt use 20% increase of demands		20,248	20,384	20,466	20,591	20,906	21,212
Archer City	0.6	336	336	336	336	336	336	336
Archer Co. Mud #1	0.15	84	84	84	84	84	84	84
Holliday	No contract amt use 20% increase of demands		277	306	314	311	310	310
Lakeside City	0.16	179	179	179	179	179	179	179
Scotland	0.18	202	202	202	202	202	202	202
Windthorst WSC	0.75	420	420	420	420	420	420	420
Dean Dale WSC (Clay County)	0.825	462	309	309	306	303	302	301
Red River Auth. (Clay County)	0.37	415	415	415	415	415	415	415
Red River Auth. (Lake Arrowhead)			see above					
Texas Parks & Wildlife (Lake Arrowhead)			see above					
Burkburnett	1.67	1,872	1,872	1,872	1,872	1,872	1,872	1,872
Dean Dale WSC (Wichita County)			153	153	156	159	160	161
Friberg Cooper WSC	0.15	168	168	168	168	168	168	168
Iowa Park	2.5	1,401	1,401	1,401	1,401	1,401	1,401	1,401
Electra	1.5	841	841	841	841	841	841	841
Wichita Valley WSC	1.205	675	675	675	675	675	675	675
Pleasant Valley	0.1	112	112	112	112	112	112	112
Sheppard A.F.B.	No contract amt use 20% increase of demands		1,175	1,141	1,115	1,103	1,100	1,100
Wichita Valley WSC	1.01	1132	1,132	1,132	1,132	1,132	1,132	1,132
Olney	1	561	561	561	561	561	561	561
Manufacturing	No contract amt. assume 60% of Wichita County Demands		738	792	792	792	792	792
Steam Electric		360	31	31	31	31	31	31
Total Demand			31,329	31,515	31,579	31,688	32,000	32,306

Table 2-6 Wholesale Water Demands for the WCWID#2 System

CUSTOMERS	CONTRACT (AF/Yr)	Demands (Acre-Feet per Year)					
		2020	2030	2040	2050	2060	2070
Archer County Irrigation		1,251	1,251	1,251	1,251	1,251	1,251
Clay County Irrigation		100	100	100	100	100	100
Wichita County Irrigation		38,256	38,256	38,256	38,256	38,256	38,256
Wilbarger Stream Electric	20,000	7,711	7,711	7,711	7,711	7,711	7,711
TPWD Dundee Fish Hatchery		2,200	2,200	2,200	2,200	2,200	2,200
TOTAL		49,518	49,518	49,518	49,518	49,518	49,518

NOTE: Major Water Provider water demands by county and river basin are provided in Appendix G.

2.3.9 Region B Water Plan

This chapter has been updated in accordance with the Texas Water Development Board requirements and all updated population and water use projections were adopted by the Region B RWPG in 2017.

LIST OF REFERENCES

Bureau of Economic Geology, University of Texas at Austin. Current and Projected Water Use in the Texas Mining and Oil & Gas Industry. Prepared for the Texas Water Development Board. June, 2011.

Bureau of Economic Geology, University of Texas at Austin. Oil & Gas Water Use in Texas: Update to the 2011 Mining Water Use Report. Prepared for the Texas Water Development Board. September, 2012.

Bureau of Economic Geology, University of Texas at Austin. Water Demand Projections for Power Generation in Texas. Prepared for the Texas Water Development Board, August, 2008.

Texas Water Development Board. DRAFT Population and Municipal Water Demand Projections Data. 2017.

Texas Water Development Board. DRAFT Non-Municipal Water Demand Projections Data. 2017.

Texas Water Development Board. Projection Methodology – Draft Population and Municipal Water Demands. April 2017.

Texas Water Development Board. Methodologies for Developing Draft Irrigation, Manufacturing, and Steam-Electric Water Demand Projections. February 2017.

Texas Water Development Board. Summary of 2021 RWP Draft Non-Municipal Water Demand Projection Methodologies and Supporting Data. June 2017.

Wichita Falls Chamber of Commerce & Industry. Wichita Falls, Texas Community Profile. 2018.

CHAPTER 3

EVALUATION OF CURRENT WATER SUPPLIES

2021 FINAL PLAN

REGION B

OCTOBER 2020

CHAPTER 3

EVALUATION OF CURRENT WATER SUPPLIES
2021 FINAL PLAN
REGION B

Under Regional Water planning guidelines, each region is to identify currently available water supplies to the region by 1) source and 2) user. The supplies available by source are based on the water available during drought of record conditions. For surface water reservoirs, this is the equivalent of firm yield supply or permitted amount (whichever is lower). For diversions directly from a stream or river (run-of-the-river), this is the minimum supply available in a year over the historical record. Groundwater supplies are defined by availability by county and aquifer. Generally, groundwater supply is the supply available with acceptable long-term impacts as determined through the Groundwater Joint Planning Process.

In addition to surface water and groundwater supplies, there are available supplies from reuse and local supplies. The available supply from reuse is based on permitted authorizations and facilities. Currently, the majority of reuse in Region B is through the City of Wichita Falls indirect potable reuse project utilizing the bed and banks of Lake Arrowhead, which can supply up to 8 million gallons per day (MGD). The remaining reuse supplies are limited to municipal irrigation and/or use at the wastewater treatment facilities; however, the City of Bowie has sold nearly all of its wastewater effluent for mining purposes in the recent past. Other entities are looking to develop reuse projects, but these projects will not be on line by 2020. Local supplies generally include stock ponds for livestock.

3.1 Existing Surface Water Supply

Water users in the Region B planning area receive surface water from sources in the Brazos, Trinity and Red River Basins. There are six major reservoirs in Region B that are used for water supply and several smaller reservoirs that were previously used for water supply or supply very small amounts of water. Brief descriptions of reservoirs in the region are included in Section 3.1.1. Other surface water sources include run-of-the-river diversion and local supplies used for livestock.

These supplies, while limited, are important to rural areas and smaller communities, especially in areas with little groundwater.

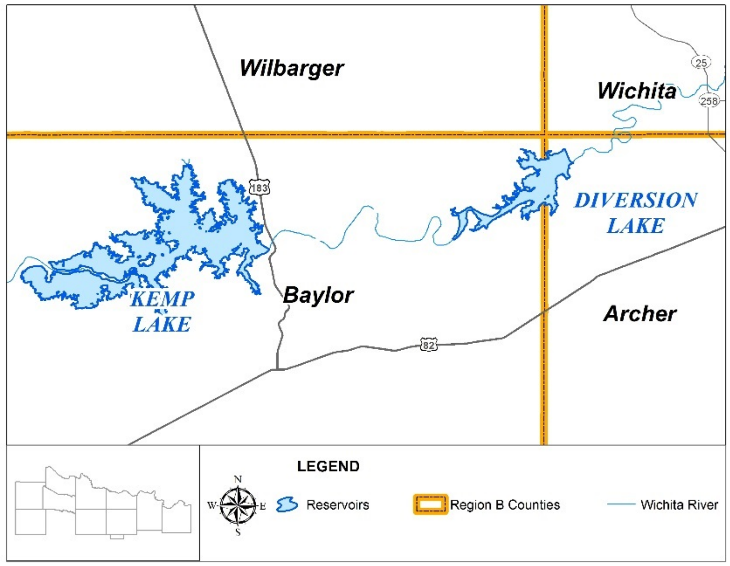
Millers Creek Lake is partially located in Region B, but used by the North Central Texas MWD in the Brazos G Region. A small amount of water is sold by the North Central Texas MWD to users in Baylor County. Greenbelt Lake is located in the Panhandle Planning Area (Region A) and is used in both Regions A and B. Descriptions of both Millers Creek Lake and Greenbelt Lake are included in Section 3.1.1.

3.1.1 Existing Water Supply Reservoirs

Greenbelt Lake

Greenbelt Lake is located in the Panhandle Planning Area (Region A), and water from the lake is used to supply several cities in Region B. The lake is owned and operated by the Greenbelt Municipal and Industrial Water Authority and is located on the Salt Fork of the Red River in Donley County near the City of Clarendon. Construction of Greenbelt Lake was completed in 1968, and the lake had an initial conservation capacity of 60,400 acre-feet. Greenbelt Municipal and Industrial Water Authority has a diversion right of 12,000 acre-feet per year from the lake to provide municipal, industrial, mining and irrigation water supply. The firm yield of the reservoir, in based on hydrology from 1940 through 2016, is estimated to be 3,964 acre-feet per year.

Lakes Kemp and Diversion



Lake Kemp is located on the Wichita River, immediately upstream of State Highway 183 in Baylor County. The lake is authorized to store 318,000 acre-feet of water. Lake Diversion was constructed approximately 20 miles downstream of Lake Kemp for secondary storage with an authorized capacity of 45,000 acre-feet. The reservoir lies in both Archer and Baylor Counties.

Lake Diversion is operated in conjunction with Lake Kemp to provide water supply for municipal, industrial, irrigation, mining and recreational purposes. The City of Wichita Falls and Wichita County Water Control and Improvement District (WCID) No. 2 own the water rights in Lake Kemp and Lake Diversion. Water released from Lake Kemp travels to Lake Diversion for distribution. Irrigation water is diverted into canal systems that distribute water to customers in Archer, Clay and Wichita Counties. Municipal water is diverted from the canal system to a pipe for transmission to Wichita Falls. American Electric Power has a contract to divert up to 20,000 acre-feet per year for the Oklaunion Power Plant in Wilbarger County. This water is diverted directly from Lake Diversion.

Due to high salinity loads in the tributaries that flow to Lake Kemp, most of the water use from Lake Kemp historically has been limited to irrigation and industrial purposes. In 2008 the City of Wichita Falls completed a reverse osmosis water treatment plant and infrastructure to utilize water from Lake Kemp for municipal purposes.

To improve the water quality of the Wichita River, the Red River Authority sponsors a chloride control project that diverts saline water from the South Wichita River above Lake Kemp to

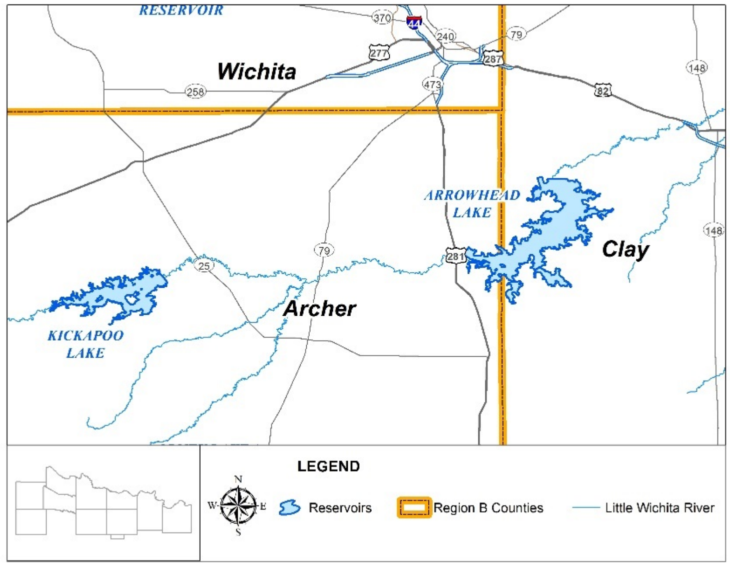
Truscott Brine Reservoir in Knox County. Evaluations of the effectiveness of the project found these diversions reduce the total chloride load to Lake Kemp by approximately 25 percent. This results in a lower chloride concentration in the reservoir. However, a significant chloride load to the reservoir system from the North and Middle Wichita Rivers remains. Future proposed low flow diversions from these tributaries should further reduce the chloride loading into Lake Kemp.

The yield of Lake Kemp and Lake Diversion was evaluated as a system with releases made to Lake Diversion with target minimum elevations in Lake Diversion of 1050.0 feet msl in March and 1046.0 feet msl the remainder of the year. The elevation of 1050.0 feet msl is to allow the Dundee Fish Hatchery to divert water during the spring spawning season. The 1046.0 feet target is based in the intake constraints for American Electric Power. The total permitted diversion for the system is 193,000 acre-feet per year. The water right allows the District to divert a portion of the irrigation right (16,660 acre-feet per year) directly from the Wichita River for irrigation purposes. This portion of the water right was evaluated as a run-of-the-river supply. However, there is no infrastructure in place to use the run-of-the-river supply.

In 2011, Kemp experienced record low inflows and high demand from the local irrigators. As a result, the lake content dropped to 20 percent of its capacity and the salinity levels increased significantly. Irrigation deliveries were suspended in 2012 and the Fish Hatchery was temporarily closed. Since then, the lake received significant inflow in 2015 and has resumed deliveries to the irrigators and the Fish Hatchery has resumed operations with limited production.

With the hydrology extended through June 2015, the estimated firm yield of the Lake Kemp/Diversion System in 2020 is 44,000 acre-feet per year.

Little Wichita River System



The Little Wichita River System consists of Lake Kickapoo and Lake Arrowhead. These lakes are owned and operated by the City of Wichita Falls for municipal and industrial supply. Water from the lakes is transported to Wichita Falls' water treatment plants for treatment and distribution. Some raw water is sold directly to wholesale customers. The firm yield of the Wichita System in 2020 is estimated at 32,670 acre-feet per year. A brief description of each lake follows:

Lake Kickapoo

Lake Kickapoo was built by the City of Wichita Falls in 1946 for municipal water supply with an initial conservation storage capacity of 106,000 acre-feet. The reservoir is located on the North Fork of the Little Wichita River in Archer County. It is owned and operated by the City of Wichita Falls. The diversion rights from the lake total 40,000 acre-feet per year.

Lake Arrowhead

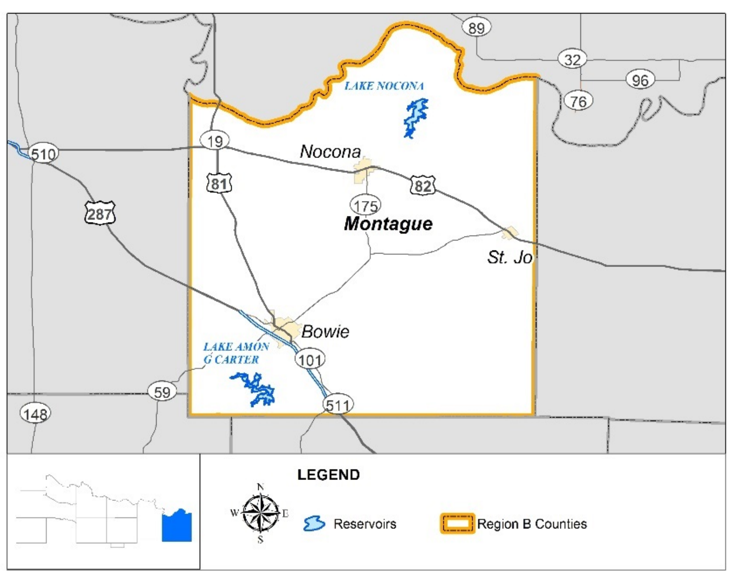
Lake Arrowhead was built in 1966 by the City of Wichita Falls for municipal, industrial and recreational use. The lake is located on Little Wichita River in Clay County, about 12 miles southeast of Wichita Falls. The lake is owned and operated by the City of Wichita Falls. The diversion rights from Lake Arrowhead total 45,000 acre-feet per year; however, the maximum diversion from both Lake Arrowhead and Kickapoo cannot exceed 65,000 acre-feet per year. This joint diversion limitation was considered in the evaluation of the system yield.

Lakes Olney and Cooper

Lakes Olney and Cooper are a twin-lake system located on Mesquite Creek in Archer County. Lake Olney dam was constructed in 1935 to provide municipal water for the City of Olney. In 1953 the dam for Lake Cooper was built for additional storage. Collectively, the lakes have a conservation storage capacity of 6,650 acre-feet with diversion rights of 1,260 acre-feet per year. Using an extended hydrology through June 2015, the firm yield of these lakes is estimated at 268 acre-feet per year.

Lake Nocona

Lake Nocona is a 25,400 acre-foot reservoir located on Farmers Creek in Montague County, approximately 8 miles northeast of the City of Nocona. Construction was completed in 1960 to provide municipal water supply to the City of Nocona. The lake is now owned and operated by the City of Nocona. The original permit for Lake Nocona allowed the diversion and use of 4,500 acre-feet per year for municipal, industrial, and mining purposes. In 1984, the final determination of water rights for the Middle Red River segment of the Red River Basin reduced the authorized diversion to 645 acre-feet per year for municipal use only. Subsequent studies reported the firm yield of the reservoir to be 1,260 acre-feet per year through year 2030 (F&N, 1986). The water right permit for diversions from Lake Nocona was amended in 1987 to 1,260 acre-feet per year for municipal, irrigation and recreational uses. The reported firm yield for Lake Nocona using the Red River WAM exceeded the permitted amount. For this plan, the firm supply from Lake Nocona is 1,260 acre-feet per year.



Amon G. Carter

Lake Amon G. Carter is located on Big Sandy Creek in Montague County, about 6 miles south of the City of Bowie, Texas. The lake was originally constructed in 1956 and enlarged in 1979. It has a current storage capacity of approximately 27,500 acre-feet and an estimated firm yield of 1,689 acre-feet per year. The lake is owned and operated by the City of Bowie for water supply. The existing water right permit allows for a diversion of 5,000 acre-feet per year for municipal, industrial and mining water use.

Miller's Creek Reservoir

Miller's Creek Reservoir is located about 7 miles southeast of Bomarton, Texas in the Brazos River Basin. The dam was constructed in 1977 on Miller's Creek in Baylor County, and the reservoir extends southwest into Throckmorton County. It is owned and operated by the North Central Texas MWA. It has a permitted diversion of 5,000 acre-feet per year for municipal, industrial and mining uses. Water from this reservoir is currently used in the Brazos G Region. A small amount of water is sold from the North Central Texas MWD to Baylor County SUD in Baylor County. The yield for Miller's Creek Reservoir was determined by the Brazos G Region. Under safe yield analysis, the Brazos G reports a reliable supply of 75 acre-feet per year in 2020, reducing to 0 acre-feet per year by 2070.

Santa Rosa Lake

Santa Rosa Lake is located in Wilbarger County on Beaver Creek. It was constructed in 1929 by the Waggoner Estate for irrigation and had an original capacity of 15,755 acre-feet. Current use is for livestock and irrigation. It is permitted for 3,075 acre-feet per year, but recent historical use is much lower. According to a representative of the Waggoner Estate, the lake went totally dry in 1971. Recent reported use from the lake is approximately 40 to 100 acre-feet per year. The Red River Basin Water Availability Model shows a firm yield that exceeds its permitted diversion. However, in light of historical performance, Santa Rosa Lake has little reliable supply (50 acre-feet per year) and is not considered a major water supply source for planning purposes.

3.1.2 Other Lakes and Reservoirs in the Region not Currently Utilized for Water Supply

There are six small lakes and reservoirs in Region B that are permitted for water supply but are no longer used. In most cases, the water right holder has developed other sources of water supply.

Below is a brief description of each of these surface water resources and the current status for water supply.

Lake Electra

Lake Electra is located on Camp Creek near the City of Electra in Wichita County. It is owned and operated by the City of Electra and has a diversion right of 600 acre-feet per year for municipal use. At normal pool elevation (1,111 feet MSL), the storage capacity of Lake Electra is 5,626 acre-feet. However, due to the relatively small drainage area (14.5 square miles), the lake is usually below its normal pool elevation. Previous reports indicate the lake may never have completely filled since construction was completed in 1950.

Due to low lake levels during drought, the City of Electra has contracted for water from Wichita Falls through the City of Iowa Park. This supply is currently in place and the City is no longer using water from Lake Electra. For planning purposes, it is assumed that there is no reliable supply from this source.

North Fork Buffalo Creek Reservoir

The North Fork Buffalo Creek Reservoir was constructed in 1964 to provide additional water for the City of Iowa Park. The dam is located below the confluence of North Fork Buffalo Creek and Lost Creek in Wichita County. The reservoir had an original storage capacity of 15,400 acre-feet with a drainage area of 33 square miles. The current permitted water right for the reservoir is 840 acre-feet per year. North Fork Buffalo Creek Reservoir is owned and operated by the City of Iowa Park. The City stopped using water from North Fork Buffalo Creek Reservoir in 2002 and is purchasing water from the City of Wichita Falls.

Lake Iowa Park

Lake Iowa Park is located on Stevens Creek, northwest of the City of Iowa Park, and was a source of water for the City of Iowa Park since 1949. The lake has a storage capacity of 2,565 acre-feet and the water right permit allows a diversion of 500 acre-feet per year for municipal use. Since

2000, the lake has experienced severe drought conditions and was nearly dry during recent droughts. The City of Iowa Park is no longer using this lake for water supply.

Lake Wichita

Lake Wichita is located south of the City of Wichita Falls and lies in Archer and Wichita Counties. It was constructed in 1901 on Holliday Creek for irrigation and municipal use, but little water has been used for municipal purposes since Lake Kickapoo water supply became available. Presently, Lake Wichita is used for recreational purposes only. Water from the Lake Kemp/Diversion System, under its recreation permitted use, is released to help maintain the water levels in Lake Wichita. There is currently no diversion structure or associated treatment facility to utilize supplies from Lake Wichita.

Lake Pauline

Lake Pauline is located on the upper reaches of Wanderers Creek near Quanah in Hardeman County. The dam was completed in 1928 and the reservoir had a reported conservation capacity of 4,137 acre-feet in 1968 (Bisset, 1999). Lake Pauline was formerly used as cooling water for a steam electric power plant. This facility is now privately owned and is used for recreation.

Bowie Lake

Bowie Lake is a small lake owned by the City of Bowie in Montague County. Bowie Lake was previously used for municipal water supply and is authorized for diversion of 1,286 acre-feet per year and to impound 800 acre-feet (CA 02-4876). The lake is now used for recreational purposes with the City of Bowie receiving its water supply from Lake Amon G. Carter.

3.1.3 Reservoir and Run-of-River Yields

The amount of supply that can be reliably used from a reservoir during drought of record conditions is often referred to as "firm yield". A firm yield analysis assumes that the reservoir never goes completely empty during the historical hydrological record, but there is little to no reserve supply during the critical period. Most reservoirs are operated with some level of reserved storage to account for minimum intake elevations, reduced water quality or future droughts worse than the historical drought. Safe yield is the amount of water that can be used during a repeat of the critical drought while leaving a minimum one-year supply in reserve. Many surface water reservoirs in Region B were permitted for safe yield and operate on a safe yield basis. For some providers, different criteria are used for operations for reliable water supplies; such as higher reserve capacity to access intake structures. Therefore, the firm yield and a more conservative safe or reliable yield analysis were conducted for planning purposes for Region B reservoirs.

In accordance with the Texas Water Development Board's (TWDB) established procedures, the surface water supplies for the regional water plans are determined using the TCEQ Water Availability Models. Water Availability Models (WAMs) have been completed for each of the major river basins in Texas. The WAMs were developed for the purpose of reviewing and granting new surface water rights permits. The assumptions in the WAMs 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. These adjustments generally included modifications to the reservoir capacities as a result of sediment accumulation over time and operational constraints as appropriate. The development of the data needed for the surface water modeling and descriptions of changes to the WAMs are documented in Appendix A.

The Red River WAM was originally completed in 2002 and includes hydrology through 1998. The TCEQ has continued to update the Red River WAM with the addition of new water right permits and/or changes to permits, but the hydrology has remained the same. Since 1998, the region has experienced several dry periods, including the current drought that began in 2011 and continued through 2015. Year 2011 had record low inflows to area lakes with record high evaporation rates. Years 2012, 2013, and 2014 were also very low inflow years to reservoirs in Region B. In 2015 the region received considerable rainfall and many of the area lakes refilled or significantly increased the storage content. To better reflect the historical drought conditions from 2011 to 2015, the hydrology for selected area lakes (including Lakes Arrowhead, Kickapoo, Kemp, Nocona and Olney-Cooper) were extended through 2015. The firm and safe yields were determined using the WAM hydrology through 1998 and the developed extended hydrology.

For the Little Wichita River System (Lakes Arrowhead and Kickapoo), and Kemp-Diversion System reservoir operation models were used to assess yields and represent system operations. Each reservoir system was analyzed separately, utilizing the respective hydrology from January 1940 to June 2015. To provide a more conservative estimate of reservoir yield for planning purposes, a reserve of 20 percent at the end of the drought of record was maintained for Lake Kemp and the Little Wichita River System. This amount of reserve is consistent with observed reservoir responses during the critical drought which prompted the City of Wichita Falls initiate Stage 5 of its Drought-Contingency Plan. The reserve capacity provides the needed water elevations to continue operations and maintain minimal water quality.

The Trinity River WAM was updated by Region C for planning purposes. Region B used this updated version to assess surface water supplies from the Trinity River Basin, including Lake Amon Carter and local run-of-the river supplies.

There is very little surface water in the Brazos River Basin that is used in Region B. The Brazos WAM developed for planning for the Brazos G Region was used to assess the supplies to users in Region B. The yield for Millers Creek Lake was developed by the Brazos G Region and reported in the Brazos G Regional Water Plan.

Table 3.1 summarizes the firm yield by reservoir source in Region B in acre-feet per year. Table 3.2 shows the supplies by reservoir that are used for regional water planning. These supply values represent the safe yield or reliable supply of the reservoir. For the smaller reservoirs that are no longer being used, the reliable supplies are assumed to be “0”.

Surface water that is diverted directly from a river (run-of-the-river) was evaluated using the TCEQ WAMs with no extended hydrology. Run-of-the-river supplies and local surface water supplies are presented in Table 3.3. Local supplies shown in Table 3.3 are based on the historical surface water use for livestock or mining as reported by the TWDB from 2005 to 2015. It is assumed that these estimates represent available surface water from stock ponds, which are not required to have a water right and are not included in the WAMs.

Table 3-1
Firm Yield of Reservoirs in Region B
-Values are in Acre-Feet per Year-

	Basin	2020	2030	2040	2050	2060	2070
WATER SUPPLY SYSTEMS							
Lake Kemp/ Diversion System	Red	44,000	39,760	35,520	31,280	27,040	22,800
Wichita System Kickapoo	Red	11,006	10,749	10,492	10,235	9,978	9,720
Arrowhead	Red	20,764	20,459	20,154	19,849	19,544	19,240
TOTAL	*Red*	*31,770*	*31,208*	*30,646*	*30,084*	*29,522*	*28,960*
Subtotal		**75,770**	**70,968**	**66,166**	**61,364**	**56,562**	**51,760**
RESERVOIRS IN REGION B							
Lake Amon Carter	Trinity	1,689	1,588	1,487	1,387	1,286	1,185
Santa Rosa Lake**	Red	3,075	3,075	3,075	3,075	3,075	3,075
Lake Cooper/Olney	Red	268	260	252	245	237	229
Lake Nocona*	Red	1,260	1,260	1,260	1,260	1,260	1,260
Subtotal		**7,586**	**7,469**	**7,352**	**7,237**	**7,118**	**7,009**
RESERVOIRS OUTSIDE REGION B							
Greenbelt Reservoir	Red	3,964	3,826	3,688	3,550	3,412	3,276
TOTAL		**87,320**	**82,263**	**77,206**	**72,151**	**67,092**	**62,045**

*Yield for Lake Nocona limited by permit amount.
**Hydrology was not extended and WAM overestimates firm yield.

Table 3-2
Reliable Supply for Reservoirs in Region B for Planning Purposes
-Values are in Acre-feet per Year-

	Basin	2020	2030	2040	2050	2060	2070
WATER SUPPLY SYSTEMS							
Lake Kemp/ Diversion System	Red	29,000	26,100	23,200	20,300	17,400	14,500
Wichita System Kickapoo	Red	5,600	5,220	4,960	4,700	4,440	3,700
Arrowhead	Red	11,300	10,500	10,160	9,820	9,480	7,300
TOTAL	*Red*	*16,900*	*15,720*	*15,120*	*14,520*	*13,920*	*11,000*
Subtotal		**45,900**	**41,820**	**38,320**	**34,820**	**31,320**	**25,500**
RESERVOIRS IN REGION B							
Lake Amon Carter	Trinity	1,270	1,182	1,094	1,006	918	830
Santa Rosa Lake	Red	50	50	50	50	50	50
Lake Cooper/Olney	Red	194	181	168	156	143	130
Lake Nocona*	Red	1,260	1,260	1,260	1,260	1,260	1,260
Subtotal		**2,774**	**2,673**	**2,572**	**2,472**	**2,371**	**2,270**
RESERVOIRS OUTSIDE REGION B							
Greenbelt Reservoir	Red	3,112	2,941	2,770	2,599	2,428	2,256
TOTAL		**51,786**	**47,434**	**43,662**	**39,891**	**36,119**	**30,026**

*Yield for Lake Nocona limited by permit amount.

Table 3-3
Summary of Local Surface Water Supplies for Region B
-Values are in Acre-Feet per Year-

	Use	County	Basin	2020	2030	2040	2050	2060	2070
LOCAL RUN-OF-THE-RIVER SUPPLIES									
Run-of-the-River[1]	Irrigation	Archer	Red	7	7	7	7	7	7
Run-of-the-River	Irrigation	Baylor	Red	0	0	0	0	0	0
Run-of-the-River	Irrigation	Baylor	Brazos	17	17	17	17	17	17
Run-of-the-River	Irrigation	Clay	Red	2,272	2,272	2,272	2,272	2,272	2,272
Run-of-the-River	Irrigation	Cottle	Red	11	11	11	11	11	11
Run-of-the-River	Irrigation	Hardeman	Red	146	146	146	146	146	146
Run-of-the-River	Irrigation	Montague	Red	108	108	108	108	108	108
Run-of-the-River	Irrigation	Wichita	Red	300	300	300	300	300	300
Run-of-the-River WCWID No. 2	Irrigation	Wichita	Red	2,752	2,752	2,752	2,752	2,752	2,752
Run-of-the-River	Irrigation	Wilbarger	Red	807	807	807	807	807	807
Run-of-the-River - Archer City Lake	Municipal -	Archer	Red	278	278	278	278	278	278
Run-of-the-River - Petrolia	Municipal -	Clay	Red	107	107	107	107	107	107
Run-of-the-River – Henrietta[2]	Municipal	Clay	Red	1,315	1,315	1,315	1,315	1,315	1,315
Run-of-the-River - Iowa Park/Gordon	Municipal -	Wichita	Red	555	555	555	555	555	555
Run-of-the-River	Municipal	Wilbarger	Red	115	115	115	115	115	115
Run-of-the-River	Industrial	Clay	Red	141	141	141	141	141	141
Run-of-the-River	Mining	Clay	Red	1	1	1	1	1	1
Run-of-the-River	Mining	Wilbarger	Red	30	30	30	30	30	30
Subtotal				**8,962**	**8,962**	**8,962**	**8,962**	**8,962**	**8,962**

[1] Run-of-the-River supplies were determined based on the TCEQ WAM Run 3 minimum annual diversion. Additional information is included in Appendix A.

2 Henrietta has an agreement in place with Wichita Falls to make releases from Lake Arrowhead for their run-of-river diversion. For Henrietta in this table supplies were determined based on the TCEQ WAM Run 3 minimum monthly diversions. Additional information is included in Appendix A.

Table 3-3 (continued)

	Use	County	Basin	2020	2030	2040	2050	2060	2070
Local Supply	Livestock[2]	Archer	Red	2,029	2,029	2,029	2,029	2,029	2,029
Local Supply	Livestock	Archer	Brazos	10	10	10	10	10	10
Local Supply	Livestock	Archer	Trinity	51	51	51	51	51	51
Local Supply	Livestock	Baylor	Red	104	104	104	104	104	104
Local Supply	Livestock	Baylor	Brazos	843	843	843	843	843	843
Local Supply	Livestock	Clay	Red	1,580	1,580	1,580	1,580	1,580	1,580
Local Supply	Livestock	Clay	Trinity	221	221	221	221	221	221
Local Supply	Livestock	Cottle	Red	171	171	171	171	171	171
Local Supply	Livestock	Foard	Red	370	370	370	370	370	370
Local Supply	Livestock	Hardeman	Red	400	400	400	400	400	400
Local Supply	Livestock	King	Red	87	87	87	87	87	87
Local Supply	Livestock	King	Brazos	55	55	55	55	55	55
Local Supply	Livestock	Montague	Red	1,221	1,221	1,221	1,221	1,221	1,221
Local Supply	Livestock	Montague	Trinity	407	407	407	407	407	407
Local Supply	Livestock	Wichita	Red	916	916	916	916	916	916
Local Supply	Livestock	Wilbarger	Red	790	790	790	790	790	790
Local Supply	Livestock	Young	Brazos	122	122	122	122	122	122
Local Supply	Mining	Hardeman	Red	7	7	7	7	7	7
Subtotal				**9,384**	**9,384**	**9,384**	**9,384**	**9,384**	**9,384**

[2] Local Supply is based on TWDB reported historical values from 2005 to 2015 which includes the drought of record and reflects firm supplies under these conditions.

3.2 Groundwater Supplies

3.2.1 General Description

While most of the water used in Region B is surface water, groundwater provides a valuable resource for parts of the region. There are two major aquifers and two minor aquifers within the Region B planning area. The central and western part of the region is primarily supplied by two aquifers, the Seymour and the Blaine. The Seymour is designated a major aquifer and is currently used in Hardeman, Wilbarger, Wichita, Clay, Baylor, and Foard Counties. The Blaine is considered a minor aquifer and useable groundwater is limited to the westernmost portion of the region. The eastern part of the region relies on the Trinity Aquifer, a major aquifer that extends from Montague County south to Bandera County in Region J and east to Red River County in Region D. The Cross Timbers Aquifer is a newly designated minor aquifer that occurs in Archer, Clay, Baylor, Montague, Wichita, Wilbarger and Young Counties. Supplies from this formation are limited, especially in the western part of the region. The locations of these aquifers are shown in Figure 3-1 and Figure 3-2.

Figure 3-1.
Major Aquifers in Region B

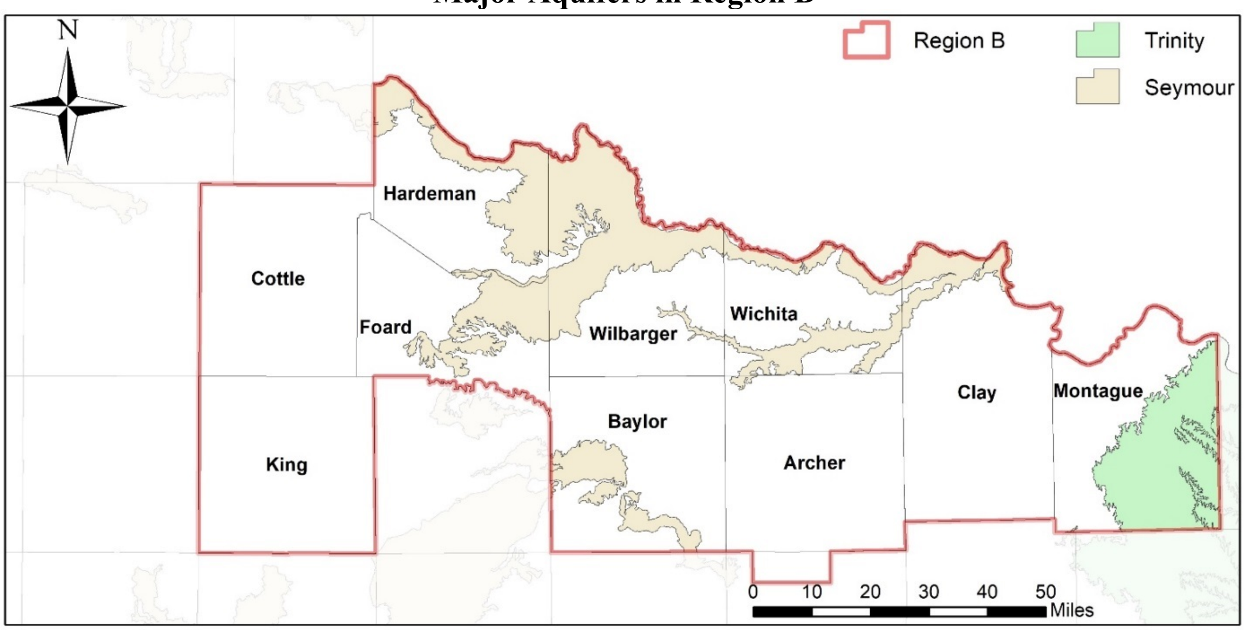
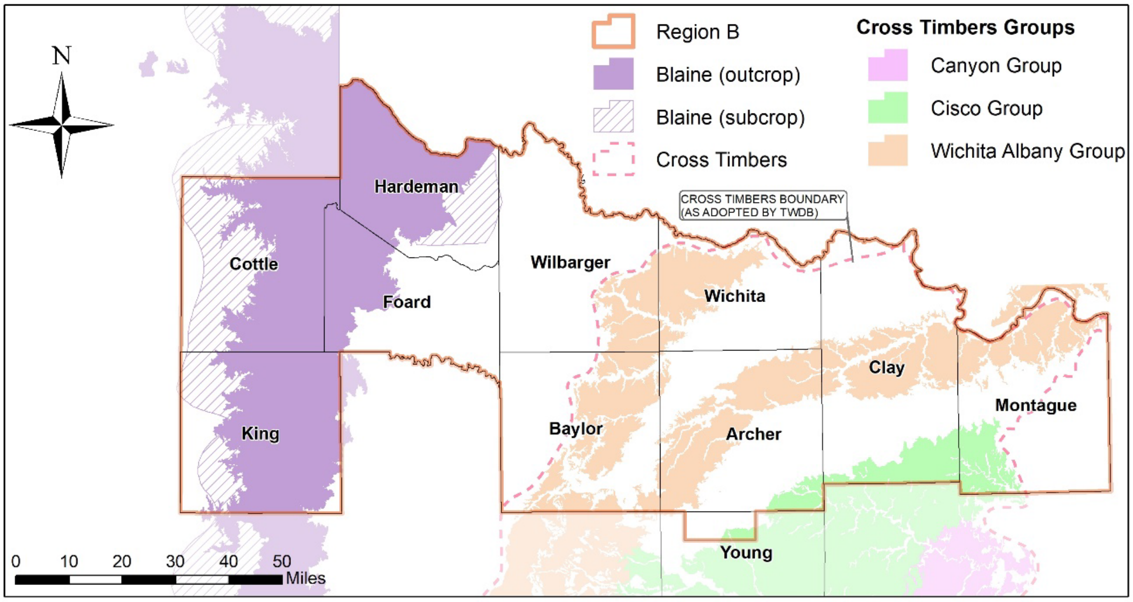


Figure 3-2.
Minor Aquifers in Region B



There are also other formations within the region that are used for groundwater supply in limited areas. The TWDB identifies these sources as "Other Aquifer". These formations generally are not well defined in the literature, but still provide water in Cottle, Foard, Hardeman, King, and Wilbarger Counties.

Seymour Aquifer

The Seymour Formation consists of isolated areas of alluvium that vary in saturated thickness from less than 10 feet to over 80 feet. This aquifer is relatively shallow and exists under water table conditions in most of its extent. Artesian conditions can occur where the water-bearing zone is overlain by clay. The upper portion of the Seymour consists of fine-grained and cemented sediments. The basal portion of the formation has greater permeability and produces greater volumes of water. Yields of wells typically range from 100 gpm to 1,300 gpm, depending on the saturated thickness, and average about 300 gpm. In areas with little saturated thickness, well yields could be less.

Recharge to the Seymour is largely due to direct infiltration of precipitation over the outcrop area. Surface streams adjoining the outcrop are at elevations lower than the water levels in the Seymour Aquifer and do not contribute to recharge. Other possible sources of recharge include infiltration from irrigation or upward leakage of water from underlying Permian formations, but these amounts are insignificant.

Natural discharge from the Seymour occurs through seeps and springs, evapotranspiration, and leakage to the underlying Permian formations. It is estimated that a large part of the Seymour's total natural discharge is from evapotranspiration from plants and is considerably larger than discharges to seeps and springs (TWDB Report 337, 1992).

Water quality of the Seymour is variable throughout the region, and generally ranges from fresh to slightly saline. Brine pollution from earlier oil activities and excessive pumping has caused localized concentrations of minerals in the alluvium, limiting the full utilization of the water resource. In addition, high nitrate concentrations occur in the groundwater over a wide area. These nitrate concentrations are often due to agricultural practices, and can be attributed to nitrogen fertilizer or leaching from areas formerly covered by nitrogen fixing vegetation such as grasses or mesquite groves. Other sources of nitrate include organic matter from poorly functioning septic systems, infiltration of animal wastes or naturally occurring sources.

Blaine Aquifer

The Blaine Formation extends in a narrow outcrop band from Wheeler to Nolan Counties. Groundwater occurs in numerous solution channels and caverns in beds of gypsum and anhydrite. In most places the aquifer exists under water table conditions, but it is also artesian where overlain by the Dog Creek Shale. Saturated thickness of the aquifer approaches 300 feet in its northern extent, and is generally less in the Region B area. Well yields vary considerably from one location to another due to the nature of solution channels. It is common for dry holes to be found adjacent to wells of moderate to high yield. The average well yield is 400 gpm.

The primary source of recharge to the Blaine Aquifer is precipitation that falls on the High Plains Escarpment to the west and the Blaine outcrop area. The solution openings and fractures in the gypsum provide access for water to percolate downward. The Blaine Aquifer may also receive some recharge from the overlying Dog Creek Shale.

Water in the Blaine Aquifer generally moves eastward through the solution channels, dissolving mineral deposits along the way, and discharging to low topographic areas. The dissolved solids concentrations in the aquifer increase with depth and generally range from 1,000 to over 10,000 mg/l. Due to the high mineral content, the TWDB has limited the extent of the Blaine Aquifer to areas with water less than 10,000 mg/l of dissolved solids.

Natural salt springs and seeps from the Blaine formation contribute to increased salinity of surface water. Due to the high mineral content the Blaine Aquifer has been used primarily for irrigation of salt tolerant crops.

Trinity Aquifer

The Trinity Group consists of three formations, the Travis Peak, Glen Rose and Paluxy. In the northern part of its extent, the Glen Rose thins out and the Travis Peak and Paluxy coalesce into a single geologic unit known as the Antlers Formation. In Region B, the Trinity Group outcrops in the eastern portion of Montague County. The thickness of the Trinity Aquifer ranges from less than 10 feet to 600 feet. Water table conditions occur in outcrop area, while artesian conditions exist in the downdip formation. Well yields in the Trinity Aquifer range from moderate to low. The effective recharge for the entire Trinity Aquifer as determined by the Texas Department of Water Resources (TDWR) is 1.5 percent of the mean annual precipitation over the outcrop area (TDWR, 1982).

Limited amounts of good quality water can be obtained from the Trinity in Montague County. Groundwater is generally used for municipal, mining, irrigation and livestock purposes. Water level declines have been recorded in heavily pumped areas to the south and southeast of Montague County.

Cross Timbers Aquifer

The Cross Timbers (formerly known as the Paleozoic Aquifer) was recently designated a minor aquifer by the TWDB. This formation has considerable extent through Region B, but production is limited. Upon review of the wells listed in the TWDB database for the Cross-Timber Aquifer, there is current production from this formation in Archer, Baylor, Clay, Montague, Wichita and Young Counties. While the formation is present in southwestern Wilbarger County, there are no known wells that produce useable water.

The TWDB has not developed a groundwater availability model for the Cross Timbers. Preliminary evaluations of this formation conducted for the Upper Trinity Groundwater Conservation District were used for supplies in the 2016 Region B Water Plan. These estimates are also used as the basis for groundwater supplies for this round of planning.

3.2.2 Modeled Available Groundwater

The State of Texas initiated a Joint Planning program to assist in determining groundwater supplies for both regulatory and planning purposes. One of the results of this planning effort was the development of groundwater availability values to be used for regional water planning. The TWDB, which oversees this initiative, divided the state into Groundwater Management Areas (GMA) based on locations of major and minor groundwater aquifers. The planning effort within each GMA is directed by the Groundwater Conservation Districts (GCDs) that fall within the GMA. Each GMA was tasked with adopting desired future conditions (DFC) of each aquifer that falls within the GMA. Based on these conditions, the TWDB developed modeled available groundwater (MAG) values that are used by the GCDs and the regional water planning groups to effectively manage the state's groundwater resources.

Most of the counties in Region B are in GMA 6, with Montague County included in GMA 8. Desired Future Conditions and the supporting MAG values were determined for each major and minor aquifer in the region within a GCD. These values are reported by county and are shown in Table 3-4. Table 3-5 shows the estimated supplies for aquifers without MAG values. In Region B, aquifers without MAGs include portions of the Seymour and Blaine not within the purview of a GCD, the Cross-Timbers, and Other Aquifer. Region B RWPG evaluated the supplies for the aquifers without MAG values using available GAM data, reported historical use, and RWPG input.

Table 3-4
Modeled Available Groundwater Values –Region B

Aquifer	County	Modeled Available Groundwater (ac-ft/yr)					
		2020	2030	2040	2050	2060	2070
Seymour (Pod 4)	Foard	11,897	4,945	5,389	8,066	7,815	3,943
	Hardeman	20,378	13,040	18,885	17,520	20,002	32,868
Seymour (Pods 7, 8)	Baylor	7,215	7,330	6,977	6,731	6,607	6,930
Blaine	Cottle	14,766	11,621	11,653	11,621	11,653	11,621
	Foard	6,582	6,564	6,582	6,564	6,582	6,564
	Hardeman	8,488	8,465	8,488	8,465	8,488	8,465
Trinity	Montague	3,886	3,875	3,886	3,875	3,886	3,875

Table 3-5
Estimated Available Groundwater Supplies for Aquifers without MAG Values*

Aquifer	County	Estimated Available Groundwater Supplies (ac-ft/yr)						*Source*
		2020	**2030**	**2040**	**2050**	**2060**	**2070**	
Seymour	Archer	35	35	35	35	35	35	*MAG, 2016 RWP*
	Clay	787	787	787	787	787	787	*MAG, 2016 RWP*
	Wichita	2,295	2,295	2,288	2,291	2,291	2,291	*MAG, 2016 RWP*
	Wilbarger	30,000	30,000	30,000	30,000	30,000	30,000	*modified GAM run*
Blaine	King	400	400	400	400	400	400	*RWPG Input***
Cross-Timbers	Archer	625	625	625	625	625	625	*2016 RWP*
	Baylor	60	60	60	60	60	60	*2016 RWP*
	Clay	2,000	2,000	2,000	2,000	2,000	2,000	*2016 RWP*
	Montague	4,000	4,000	4,000	4,000	4,000	4,000	*2016 RWP*
	Wichita	840	840	840	840	840	840	*2016 RWP*
	Young	700	700	700	700	700	700	*2016 RWP*
Other Aquifer	Cottle	1,800	1,800	1,800	1,800	1,800	1,800	*Historical Use, 2016 RWP*
	Foard	200	200	200	200	200	200	*Historical Use, 2016 RWP*
	Hardeman	50	50	50	50	50	50	*Historical Use, 2016 RWP*
	King	650	650	650	650	650	650	*Historical Use, 2016 RWP*
	Wilbarger	3,050	3,050	3,050	3,050	3,050	3,050	*Historical use (2010-2015)*

*Imported groundwater comes from the Ogallala Aquifer in Region A and Dickens County in Region O. Values are shown in Table 3-8.
** A groundwater technical committee was formed as a subset of the RWPG that provided input on these values based on local knowledge of pumping.

3.2.3 Springs in Region B

The most comprehensive source of information on major springs in Texas was published in 1981 (Brune, 1981). This work identified six major springs in Region B that are listed in Table 3-6. Some of these springs had historical significance as water supplies for nomadic Indians and western travelers. None of these springs are currently used for water supply, and at least one is no longer flowing.

Table 3-6
Major Springs in Region B

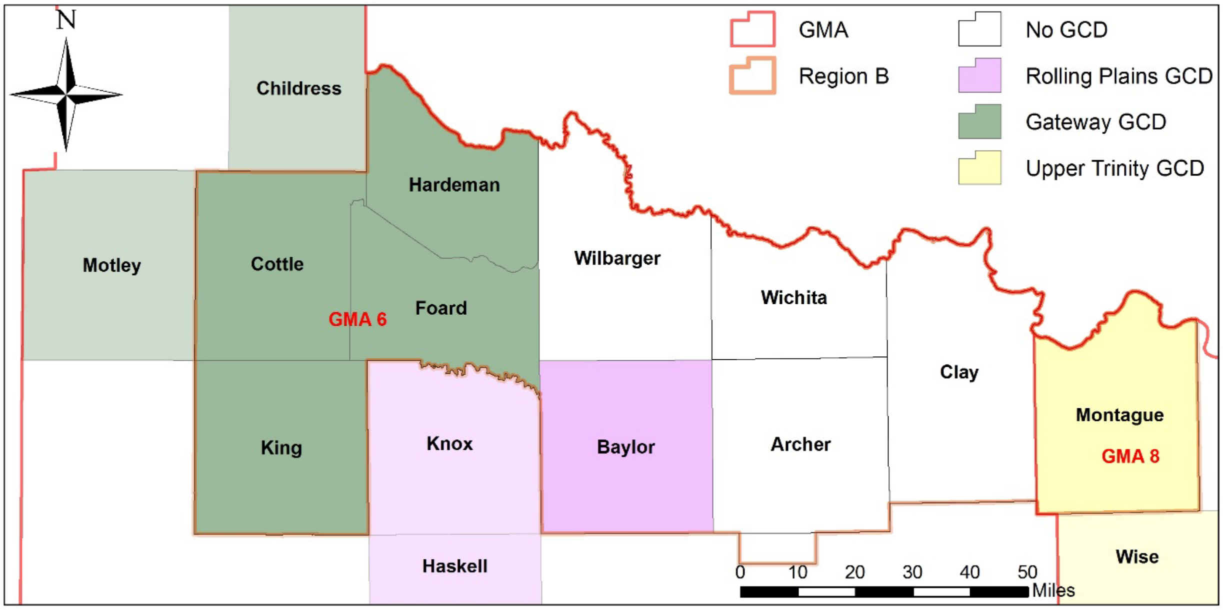
County	Spring	Location	Status
Baylor	Buffalo Springs	3 miles west of Seymour	Flow at 25 gpm in 1969
Clay	Buffalo Springs	At Buffalo Springs	Uncertain
Montague	Barrel Springs		No longer flowing
Wichita	China Springs	2 miles west of Haynesville	Brackish water flow at 100 gpm in 1970
Wilbarger	Doans Springs	1 mile northwest of Doans	Flowing in 1970. Impounded in a recreational lake.
	Condon Springs	3 miles northwest of Vernon	Flowing in 1969

3.2.4 Groundwater Conservation Districts

There are three groundwater conservation districts located in Region B. The Rolling Plains GCD covers Baylor, Knox and Haskell Counties. Only Baylor County is in Region B, which uses water from the Seymour and Cross Timbers Aquifer. The Gateway GCD covers Cottle, Foard and Hardeman and King Counties in the northwestern part of Region B. King County asked to join Gateway GCD in July 2018. In November, Gateway GCD voted and approved King County to allow them to join the District. Both the Blaine and Seymour Aquifers are present in this District. The Upper Trinity GCD includes Montague County in the eastern part of the region, which includes the Trinity and Cross Timbers Aquifers. As previously discussed, the GCDs have an important role in the Joint Planning process and development of the groundwater supplies used for regional water planning. The three GCDs and two GMAs are shown in Figure 3-3.

Figure 3-3.

Groundwater Conservation Districts and Pods of the Seymour Aquifer in Region B



3.2.5 Priority Groundwater Management Areas

In areas, where there is no GCD, the state may designate a Priority Groundwater Management Area (PGMA). The Priority Groundwater Management Area (PGMA) process is initiated by the TCEQ, who designates a PGMA when an area is experiencing critical groundwater problems, or is expected to do so within 50 years. These problems include shortages of surface water or groundwater, land subsidence resulting from groundwater withdrawal, or contamination of groundwater supplies. Once an area is designated a PGMA, landowners have two years to create a Groundwater Conservation District (GCD). Otherwise, the TCEQ is required to create a GCD or to recommend that the area be added to an existing district. The TWDB works with the TCEQ to produce a legislative report every two years on the status of PGMAs in the state. The PGMA process is completely independent of the current Groundwater Management Area (GMA) process and each process has different goals. The goal of the PGMA process is to establish GCDs in these designated areas so that there will be a regulating entity to address the identified groundwater issues.

In February 2009, Montague County was identified as part of the North – Central Texas Trinity and Woodbine Aquifers PGMA. Since that time all the counties in the PGMA with the exception of Dallas County have been included in a GCD. As of this time, no county commissioner's court has promulgated groundwater regulations or availability values for Montague County, which is currently regulated by the Upper Trinity GCD.

3.3 Wastewater Reuse Supplies

In 2018, Wichita Falls completed an indirect potable reuse project utilizing the bed and banks of Lake Arrowhead which can supply up to 8 MGD. Treated wastewater from the Wichita Falls Resource Recovery Facility is pumped 17.5 miles to Lake Arrowhead where it is blended within the lake. Following blending, water is pumped to the Secondary Reservoir then diverted to the Jasper WTP and Cypress WTP for treatment and distribution as drinking water.

The City of Bowie sells treated wastewater to oil and gas customers within Montague county. It is anticipated that these sales will continue through 2040 when the demand is expected to diminish as shown in Table 3-7.

Table 3-7
Water Reuse Supplies Region B
-Values are in Acre-feet per Year-

Seller	Recipient	2020	2030	2040	2050	2060	2070
City of Bowie	Mining, Montague County	348	351	349	0	0	0
Cities of Burkburnett/Wichita Falls	Manufacturing, Wichita County	357	357	357	357	357	357
City of Nocona	Irrigation, Montague County	16	16	16	16	16	16
City of Olney	Golf Course	5	5	5	5	5	5
City of Seymour	Salt Fork Golf Course	63	63	63	63	63	63
City of Wichita Falls	Wichita Falls and Customers	8,968	8,968	8,968	8,968	8,968	8,968
Total		**9,757**	**9,760**	**9,758**	**9,409**	**9,409**	**9,409**

The reuse projects identified in Table 3-7 represent the major reuse projects in the Region for water supply purposes. There are smaller direct reuse projects (210 authorizations) that are utilized to meet municipal or industrial demand that are not reported in this table.

3.4 Inter-Basin Transfers and Inter-Region Transfers

There is only one known inter-basin transfer in Region B. This is from Lake Kickapoo in the Red River Basin to the City of Olney in the Brazos Basin. The City of Olney has a contract with the City of Wichita Falls to provide 1 MGD of water during peak demands. Most years this additional supply is not used or minimally used.

Inter-regional transfers occur from the Panhandle Planning Area to Region B through the Greenbelt Municipal and Industrial Water Authority, a small amount from Miller's Creek in Region G and groundwater from Dickens County in Region O. Inter-regional transfers by source and region are shown in Table 3-8.

Table 3-8
Inter-Regional Transfers
-Values are in Acre-feet per Year-

Source	Region	2020	2030	2040	2050	2060	2070
Greenbelt Lake	A	869	895	921	799	748	686
Other Aquifer – Dickens County	O	64	62	62	61	61	61
Ogallala Aquifer – Donley County	A	530	492	458	358	306	257
Millers Creek Reservoir	G	6	5	4	2	1	0
Total		**1,469**	**1,454**	**1,445**	**1,220**	**1,116**	**1,004**

3.5 Allocation of Existing Supplies

3.5.1 Water User Groups

To assess the projected water shortages in the region, the amount of water that is available to each water user is determined. This allocation process considers water rights, contracts, the reliable supply from the source, and current infrastructure capacities (well fields, transmission and treatment). The amount allocated to a user is restricted to the most restraining limitation. Obligations to provide water to other users through sales is also considered during the allocation process. Surface water use reported to TWDB for livestock watering was assumed supplied by on farm stock ponds.

In cases where there is insufficient water to meet the users' demands, the supplies were generally shorted equally among the entities. This generally occurred for wholesale water providers that have insufficient supplies to meet retail and customer demands. In several instances, all or nearly all of the available supply from a source was allocated to existing water users. This means that there are limited supplies from these sources for future water management strategies without the transfer of water from another entity.

The supplies to each water user are shown in the Water User Group Summary Tables in Appendix B. A summary of the currently available supplies by county is presented in Table 3-9.

Table 3-9

Summary of Currently Available Supplies to Water Users by County
-Values are in Acre-feet per Year-

County	2020	2030	2040	2050	2060	2070
Archer	5,291	5,226	5,102	4,963	4,813	4,507
Baylor	7,125	7,124	7,123	7,121	7,120	7,119
Clay	6,830	6,956	6,734	6,596	6,458	6,348
Cottle	5,411	5,411	5,408	5,304	5,301	5,301
Foard	4,213	4,207	4,204	4,126	4,088	4,050
Hardeman	14,560	14,554	14,549	14,405	14,339	14,266
King	908	857	815	776	744	744
Montague	8,994	8,905	7,819	7,107	7,127	7,046
Wichita	46,351	43,165	40,626	38,106	35,601	31,061
Wilbarger	40,207	39,605	39,001	38,398	37,794	37,183
Young (P)	964	954	927	902	872	796
TOTAL	**140,854**	**136,964**	**132,308**	**127,804**	**124,257**	**118,421**

3.5.2 Major Water Providers

A major water provider is 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 Region B RWPG designated two major water providers: The City of Wichita Falls and the Wichita County Water Improvement District No. 2. Both of these entities are considered major providers because they provide significant quantities of water to users over a wide geographic area. These providers also are responsible for the four largest surface water sources in the region. Wichita Falls currently receives water from three primary sources: Lake Arrowhead, Lake Kickapoo and

Lake Kemp. It also reuses up to 8 MGD of treated wastewater effluent. Wichita Falls has water rights for Lake Wichita, but this lake is currently used only for recreational purposes. The total available supply to Wichita Falls is shown in Table 3-10.

Table 3-10
Available Supply to Wichita Falls
-Values are in Acre-feet per Year-

Reliable Supply[1]	2020	2030	2040	2050	2060	2070
Kickapoo	5,600	5,220	4,960	4,700	4,440	3,700
Arrowhead	11,300	10,500	10,160	9,820	9,480	7,300
Wichita System	***16,900***	***15,720***	***15,120***	***14,520***	***13,920***	***11,000***
Kemp Municipal[2]	2,948	2,652	2,357	2,063	1,768	1,474
Indirect Reuse	8,968	8,968	8,968	8,968	8,968	8,968
Total – Wichita Falls	**28,816**	**27,340**	**26,445**	**25,551**	**24,656**	**21,442**

1. The reliable supply for the Wichita System is based on a yield analysis with a 20% reserve supply at the end of the drought of record.
2. Supply from Lake Kemp is limited by the proportional yield with a 20% reserve supply for municipal use and assuming a 25 percent loss during reverse osmosis treatment.

Wichita County Water Improvement District (WID) No. 2 owns and operates water in Lake Kemp jointly with the City of Wichita Falls. Wichita County WID No. 2 supplies irrigation water to users in Archer, Clay and Wichita Counties. The City of Wichita Falls and WID No. 2 administer a contract with American Electric Power for 20,000 acre-feet per year for the Oklaunion Power Plant. Table 3-11 shows the amount of supply available to WID No. 2 based on the proportional yield from Kemp/Diversion System for irrigation and industrial use. For simplicity, the entire amount of supply for American Electric Power is shown with WID No. 2.

Table 3-11
Available Supply to Wichita County Water Improvement District No. 2
-Values are in Acre-feet per Year-

Reliable Supply	2020	2030	2040	2050	2060	2070
Kemp - Irrigation	18,182	16,363	14,545	12,727	10,909	9,091
Kemp - Industrial	6,010	5,409	4,808	4,207	3,606	3,005
Kemp – Livestock[1]	0	0	0	0	0	0
Total – WID No. 2	**24,192**	**21,772**	**19,353**	**16,934**	**14,515**	**12,096**

1. The water for livestock is for the Dundee Fish Hatchery.

3.6 Summary of Currently Available Supplies

The total amount of supply currently available to Region B is approximately 200,000 acre-feet per year, as shown on Table 3-12. This includes all groundwater in place and reliable supplies from surface water and reuse. By 2070, the supply to Region B decreases by about 20,000 acre-feet per year. This is mostly due to the reduced storage capacities of existing reservoirs due to sediment accumulation.

The supply to water users totals approximately 140,000 acre-feet per year, which is less than the total available regional supply due to operational and contractual constraints, infrastructure limitations, and water treatment capacities. Most of the unallocated supplies is groundwater that has not been developed to date. The amount of water available by source for Region B is included in Appendix G, TWDB Database Reports. Source water supplies remaining that are not currently used are shown in Table 3-13. A comparison of the regional supply to the supply available to the water users is shown on Figure 3-4.

Table 3-12
Summary of Reliable Supplies to Region B Water Users
-Values are in Acre-feet per Year-

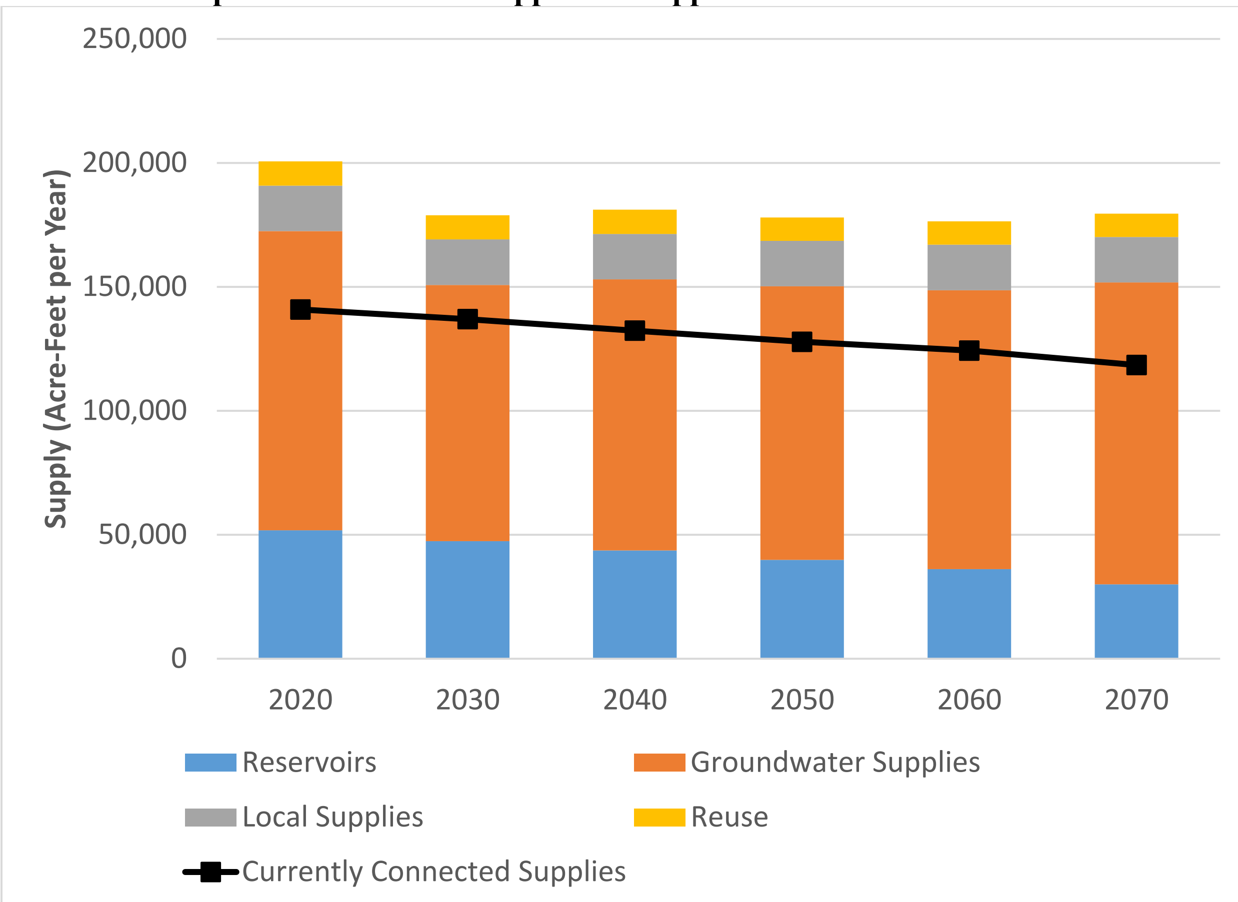
	2020	2030	2040	2050	2060	2070
Reservoirs in Region B	48,674	44,493	40,892	37,292	33,691	27,770
Reservoirs outside Region B[1]	3,112	2,941	2,770	2,599	2,428	2,256
Run-of-the-River Supplies	8,962	8,962	8,962	8,962	8,962	8,962
Local Supplies	9,384	9,384	9,384	9,384	9,384	9,384
Groundwater Supplies	120,704	103,332	109,345	110,330	112,521	121,754
Reuse	9,757	9,760	9,758	9,409	9,409	9,409
Total	**200,593**	**178,872**	**181,111**	**177,976**	**176,395**	**179,535**

1. The supply reported for reservoirs outside of Region B is the safe yield of Greenbelt Reservoir

Table 3-13
Source Water Supply Remaining
-Values are in Acre-feet per Year-

	2020	2030	2040	2050	2060	2070
Groundwater	50,333	32,830	40,068	41,583	43,801	53,019
Reuse	0	0	0	0	0	0
Surface Water	7,716	7,544	7,361	7,159	6,973	6,786
Total	**58,049**	**40,374**	**47,429**	**48,742**	**50,774**	**59,805**

Figure 3-4.
Comparison of Reliable Supplies to Supplies Available to Water Users



LIST OF REFERENCES

Alan Plummer & Associates. Wichita River Basin Chloride Monitoring Data Review, prepared for Red River Authority, January 1998.

Biggs and Matthews, Inc. Report of North Fork Buffalo Creek Project, Iowa Park, Texas, December 1961.

Bissett, Chris (of West Texas Utility Company). Communication with Simone Kiel (of Freese and Nichols, Inc.), September 8, 1999.

Espey Consultants. Water Availability Models for the Red and Canadian River Basins, prepared for the Texas Natural Resource Conservation Commission, March 2002.

Freese and Nichols, Inc., Assessment of Potential Water Supplies, prepared for Greenbelt Municipal and Industrial Water Authority, December 2011.

Freese and Nichols, Inc., Evaluation of Wichita Falls' Current Surface Water Sources Technical Memorandum, April 2014.

Freese and Nichols, Inc., Long-Range Water Supply Plan for the City of Wichita Falls, January 2015, Revised January 2016.

Freese and Nichols, Inc., Long-Range Water Supply Plan for the City of Olney, March 2016.

Freese and Nichols, Inc., Report on the Camp Creek Reservoir Project – Electra, Texas, 1948.

Freese and Nichols, Inc. Master Plan for Water Resource Development in the Texas Portion of the Red River Basin, *Part I, The Little Wichita River*, September 1961.

Freese and Nichols, Inc. Master Plan for Water Resource Development in the Texas Portion of the Red River Basin, *Part III, The Red River and its Texas Intrastate Tributaries above the Mouth of the Little Wichita River*, May 1967.

Freese and Nichols, Inc., Report on Future Water Requirements and Yield of Lake Nocona, prepared for the North Montague County Water Supply District, 1986.

Freese and Nichols, Inc., Project ELC87022 – Amendment to Permit, Lake Electra, 1987.

Freese and Nichols, Inc., Update Yield Study for Existing Greenbelt Lake, January 1996.

R.W. Harden & Associates, Inc., Northern Trinity/Woodbine Aquifer Groundwater Availability Model, prepared for the Texas Water Development Board, August 2004.

TDWR, Report 269: Occurrence, Availability, and Chemical Quality of Groundwater in the Cretaceous Aquifers of North Central Texas, April 1982.

Texas Commission on Environmental Quality, Water Rights Database, April, 2018.

Texas Water Development Board (TWDB), Report 337. Evaluation of Water Resources in Parts of the Rolling Prairies Region of North Central Texas, March 1992.

TWDB, Report 345. Aquifers of Texas, November 1995.

TWDB, Brazos WAM, May 2004

TWDB, Red River WAM, June 2004.

TWDB, Trinity WAM, July 2004

TWDB, Volumetric Survey, Lake Arrowhead, September 2013, http://www.twdb.texas.gov/surfacewater/surveys/completed/files/Arrowhead/2013-09/Arrowhead2013_FinalReport.pdf?d=1546543978509

TWDB, Volumetric Survey, Lake Kickapoo, September 2013, http://www.twdb.texas.gov/surfacewater/surveys/completed/files/Kickapoo/2013-09/Kickapoo2013_FinalReport.pdf?d=1546543978509

TWDB, Volumetric Survey, Lake Nocona, July 2001, http://www.twdb.texas.gov/surfacewater/surveys/completed/files/Nocona/2001-07/Nocona2001_FinalReport.pdf?d=1546543978509

TWDB, Volumetric Survey of Lake Kemp, 2006. http://www.twdb.texas.gov/surfacewater/surveys/completed/files/Nocona/2001-07/Nocona2001_FinalReport.pdf?d=1546543978509

Wilbarger County Regional Water Supply, Preliminary Reconnaissance Study, May 1988.

Woodward-Clyde, Draft Report- Groundwater Resources Study for Odell-Winston and Round Timber Ranch Well Fields, prepared for the City of Vernon, October 1998.

CHAPTER 4

IDENTIFICATION OF WATER NEEDS

2021 FINAL PLAN

REGION B

OCTOBER 2020

CHAPTER 4

IDENTIFICATION OF WATER NEEDS
2021 FINAL PLAN
REGION B

4.1 Introduction

Water needs are identified by calculating the difference between currently available supplies and the projected demands. This chapter outlines water needs based on the quantity of water that is currently available to a user, the quality of water for its intended use, and the reliability of existing supplies as assessed by a safe supply analysis. The water needs are also discussed for First-Tier and Second-Tier water needs scenarios, where the First-Tier needs are based on all supply limitations identified in Chapter 3 and Second-Tier needs are those needs after conservation and direct reuse strategies have been implemented.

This comparison of developed water supply to demands is made for the region, county, basin, major water provider (MWP), and water user group (WUG). If the projected demands for an entity exceed the developed supplies, then a shortage is identified (represented by a negative number in Appendix B). For some users, the supplies may exceed the demands (positive number).

A comparison of current supply to demand was performed using the projected demands developed in Chapter 2 and the allocation of existing supplies developed in Chapter 3 as evaluated under drought of record conditions. As discussed in Chapter 3, allocations of existing supplies to water providers (WUGs and MWPs) were based on the most restrictive of current water rights, contracts, available yields for surface water, and modeled available groundwater (MAG) for groundwater. For some aggregated water users (e.g., irrigation), reported historical use was also considered during the allocation process. Water quality was addressed to some extent by not assigning supplies with known impaired water quality (e.g., nitrates and high salinity) for municipal use. This included some users of the Seymour Aquifer and most of the Blaine Aquifer. Further discussion of water quality issues and the effect on supply is presented in Section 4.4.

4.2 First-Tier Water Needs Analysis

The First-Tier water needs represent the water quantity needs without consideration of water conservation or direct reuse. On a regional basis, there is a projected shortage of 15,624 acre-feet in 2020 and a maximum project shortage of 36,084 acre-feet in 2070, as shown in Table 4-1 and Figure 4-1. These needs are calculated by subtracting the regional demand from the total regional water supply. It includes both shortages for some water users and surpluses for others. Considering only the shortages, a summary of the need by county is presented in Table 4-2, which ranges from 24,745 acre-feet in 2020 to 41,256 acre-feet in 2070.

Table 4–1
Comparison of Supplies and Demands for Region B
-Values are in Acre-Feet per Year-

	2020	2030	2040	2050	2060	2070
Supply	140,854	136,964	132,308	127,804	124,257	118,421
Demand	156,489	156,083	154,727	153,806	154,108	154,535
Surplus/Storage	**-15,635**	**-19,119**	**-22,419**	**-26,002**	**-29,851**	**-36,114**

Figure 4-1
Region B Supplies and Demands (ac-ft/yr)

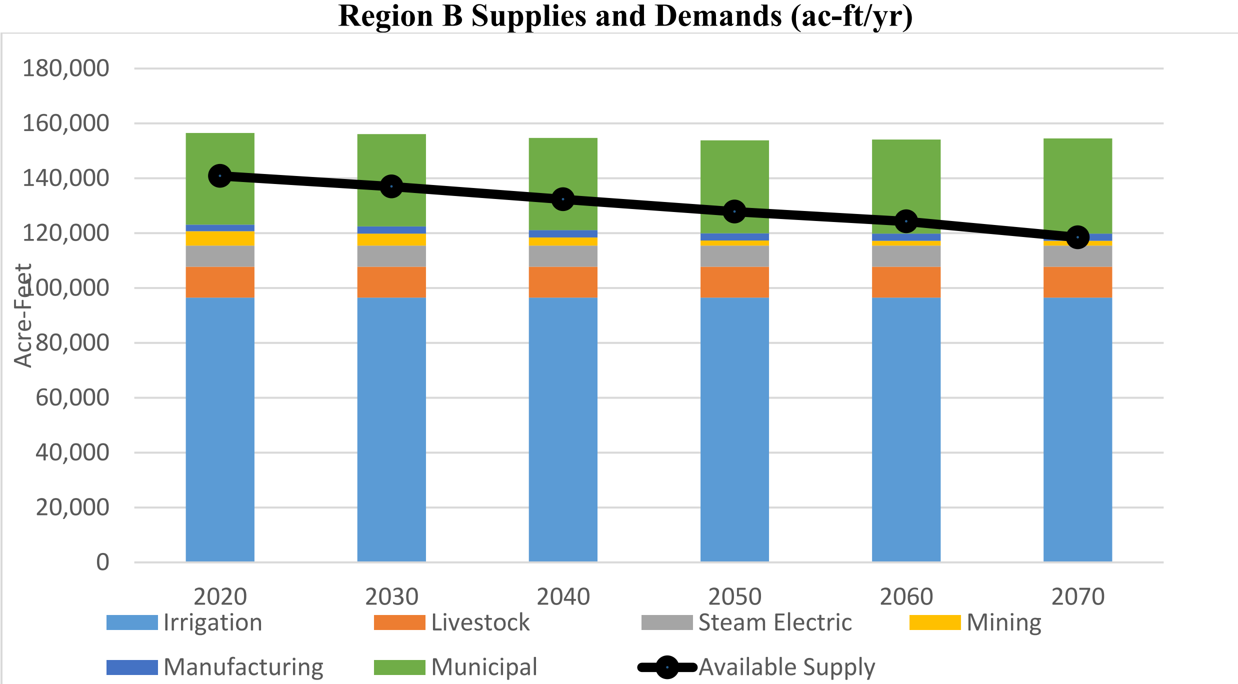


Table 4-2
Comparison of Supply and Demand by County
-Values are in Acre-feet per Year-

County	2020	2030	2040	2050	2050	2070
Archer	-905	-1,075	-1,015	-1,033	-1,058	-1,237
Baylor	0	0	0	0	0	0
Clay	-4	-10	-13	-17	-22	-89
Cottle	0	0	0	0	0	0
Foard	0	0	0	0	-13	-24
Hardeman	0	0	0	-23	-94	-177
King	0	0	0	0	0	0
Montague	-1,291	-226	-274	-110	-208	-305
Wichita	-20,830	-22,810	-25,291	-27,734	-30,296	-34,580
Wilbarger	-1,715	-2,320	-2,925	-3,531	-4,136	-4,788
Young (P)	0	0	0	0	0	-56
Total	**-24,745**	**-26,441**	**-29,518**	**-32,448**	**-35,827**	**-41,256**

4.2.1 Identified Shortages for Water User Groups

A shortage occurs when developed supplies are not sufficient to meet projected demands. In Region B, there are twenty-seven water user groups with identified water quantity shortages during the planning period.

Total shortages for all water user groups are projected to be approximately 24,745 acre-feet per year in 2020, increasing to 29,518 acre-feet per year in 2040 and approximately 41,256 acre-feet per year by the year 2070. Table 4-3 lists the water user groups with projected water shortages. The comparison of supply versus demands by user group for Region B is presented in the Water User Group Summary Tables in Appendix B.

A summary of when the individual water user group shortages begin by county and demand type is presented in Table 4-4.

Table 4-3
Projected Water Shortages for Water User Groups
-Values are in Acre-feet per Year-

Water User Group	2020	2030	2040	2050	2060	2070
Archer City	0	0	0	0	0	-20
Archer County MUD 1	-63	-61	-63	-65	-68	-78
Holliday	0	-4	-13	-22	-31	-64
Lakeside City	0	0	0	0	0	0
Scotland	0	-43	-47	-54	-63	-87
Windthorst WSC	-13	-30	-42	-54	-71	-121
County-Other - Archer	-38	-19	-13	-12	-11	-11
Irrigation - Archer	-470	-527	-585	-642	-699	-757
Mining - Archer	-325	-401	-265	-201	-137	-137
Red River Authority	0	0	0	-23	-48	-123
Crowell	0	0	0	0	-13	-24
Quanah	0	0	0	0	-36	-76
Manufacturing - Hardeman	0	0	0	0	-10	-29
Bowie	0	0	-17	-110	-208	-305
Mining - Montague	-1,291	-226	-257	0	0	0
Electra	-133	-164	-202	-246	-290	-395
Harrold WSC	-16	-20	-25	-30	-35	-49
Iowa Park	0	0	0	0	0	-35
Sheppard AFB	0	-14	-45	-78	-113	-225
Wichita Falls	0	-177	-831	-1,441	-2,162	-4,333
Irrigation - Wichita	-20,695	-22,452	-24,208	-25,964	-27,720	-29,476
Manufacturing - Wichita	0	0	0	0	-3	-103
Steam Electric Power - Wichita	0	-1	-2	-2	-4	-7
Vernon	0	0	0	0	0	-26
Manufacturing - Wilbarger	0	0	0	0	0	-13
Steam Electric Power - Wilbarger	-1,701	-2,302	-2,903	-3,504	-4,105	-4,706
Olney	0	0	0	0	0	-56
Total	**-24,745**	**-26,441**	**-29,518**	**-32,448**	**-35,827**	**-41,256**

Table 4-4
Decade Shortage Begins by County and Category

County	Irrigation	Municipal	Manufacturing	Mining	Steam Electric Power	Livestock
Archer	2020	2020	-	2020	-	-
Baylor	-	-	-	-	-	-
Clay	-	2020	-	-	-	-
Cottle	-	-	-	-	-	-
Foard	-	2060	-	-	-	-
Hardeman		2050	2060	-	-	-
King	-	-	-	-	-	-
Montague	-	2040	-	2020	-	-
Wichita	2020	2020	2060	-	2030	-
Wilbarger		2020	2070	-	2020	-
Young	-	2070	-	-	-	-

Irrigation

Irrigation shortages are identified for Archer and Wichita Counties. The shortages for Archer and Wichita counties are associated with reduced supplies from Lake Kemp.

Table 4-5
Projected Irrigation Shortages in Region B
-Values are in Acre-feet per Year

County	2020	2030	2040	2050	2050	2070
Archer	-470	-527	-585	-642	-699	-757
Wichita	-20,695	-22,452	-24,208	-25,964	-27,720	-29,476
Total	**-21,165**	**-22,979**	**-24,793**	**-26,606**	**-28,419**	**-30,233**

Municipal

Municipal shortages are identified in Archer, Clay, Foard, Hardeman, Montague, Wichita, Wilbarger and Young Counties. Many of the municipal water users in these counties are provided supplies through a wholesale or major water provider, which is shown to have shortages associated with surface water supplies.

Table 4-6
Projected Municipal Shortages in Region B
-Values are in Acre-feet per Year

County	2020	2030	2040	2050	2050	2070
Archer	-110	-147	-165	-190	-222	-343
Clay	-4	-10	-13	-17	-22	-89
Foard	0	0	0	0	-13	-24
Hardeman	0	0	0	-23	-84	-148
Montague	0	0	-17	-110	-208	-305
Wichita	-135	-427	-1,081	-1,719	-2,526	-4,994
Wilbarger	-14	-18	-22	-27	-31	-69
Young	0	0	0	0	0	-56
Total	**-263**	**-602**	**-1,298**	**-2,086**	**-3,106**	**-6,028**

Manufacturing

There are three counties with manufacturing shortages identified in Region B. Most manufacturing interests buy water from retail providers or develop their own groundwater supplies. For each of the counties, the shortages are associated with limited supplies from major and wholesale water providers.

Table 4-7
Projected Manufacturing Shortages in Region B
-Values are in Acre-feet per Year

County	2020	2030	2040	2050	2050	2070
Hardeman	0	0	0	0	-10	-29
Wichita	0	0	0	0	-3	-103
Wilbarger	0	0	0	0	0	-13
Total	**0**	**0**	**0**	**0**	**-13**	**-145**

Mining

Mining shortages are identified for Archer and Montague Counties. Shortages for Montague County are identified for 2020, 2030, and 2040 and are associated with the projected increased oil and gas mining activities. However, these activities have slowed down in recent years and the demand for water has decreased.

Table 4-8
Projected Mining Shortages in Region B
-Values are in Acre-feet per Year

County	2020	2030	2040	2050	2050	2070
Archer	-325	-401	-265	-201	-137	-137
Montague	-1,291	-226	-257	0	0	0
Total	**-1,616**	**-627**	**-522**	**-201**	**-137**	**-137**

Steam Electric Power

Steam Electric Power shortages are identified for Wichita and Wilbarger Counties. The shortage for steam electric power in Wilbarger County is associated with reduced supplies from Lake Kemp for the Oklaunion Power Plant. This plant is scheduled to be closed in 2020 by American Electric Power. At this time there is no known electric power producer that would use these supplies but the demands continue to be shown in the Region B Water Plan until a known user for these water rights are identified. The shortages in Wichita County are associated with a small electric generating facility in Wichita Falls that is supplied by Wichita Falls.

Table 4-9
Projected Steam Electric Power Shortages in Region B
-Values are in Acre-feet per Year

County	2020	2030	2040	2050	2050	2070
Wichita	0	-1	-2	-2	-4	-7
Wilbarger	-1,701	-2,302	-2,903	-3,504	-4,105	-4,706
Total	**-1,701**	**-2,303**	**-2,905**	**-3,506**	**-4,109**	**-4,713**

Livestock

No shortages for livestock water were identified.

4.2.2 Comparison of Supply and Demand for Major Water Providers

Region B has two major water providers: City of Wichita Falls and Wichita County Water Improvement District (WID) No. 2. The City of Wichita Falls is a regional provider for much of the water in Wichita, Archer, and Clay Counties. The City also provides water to customers as far away as the City of Olney in Young County. Considering current customer contracts and City demands, Wichita Falls has a firm need of 400 acre-feet per year in 2030, which increases to approximately 7,000 acre-feet per year by 2070. When applying the safe supply requirements of 20 percent above the firm demands for the City and customers without a specified contract amount (Holliday, Sheppard AFB and Wichita County Manufacturing), the safe supply need for Wichita Falls increases to over 2,500 acre-feet per year in 2020 and nearly 11,000 acre-feet by 2070. A summary of the supply and demand comparison for Wichita Falls is shown in Table 4-10. A more detailed analysis is included in Appendix G.

Table 4-10
Projected Water Shortages for the City of Wichita Falls
-Values are in Acre-feet per Year-

	2020	2030	2040	2050	2060	2070
Total Firm Demand	27,589	27,744	27,797	27,888	28,148	28,403
Total Supplies	28,816	27,340	26,445	25,551	24,656	21,442
Supplies Less Current Customer Demand	1,227	-404	-1,352	-2,337	-3,492	-6,961
Firm Need by Category	2020	2030	2040	2050	2060	2070
Manufacturing	27	-10	-32	-55	-82	-162
Municipal	1,198	-394	-1,319	-2,279	-3,407	-6,792
Steam Electric Power	1	0	-2	-3	-4	-8
Total Firm Need	1,227	-404	-1,352	-2,337	-3,492	-6,961
Required Safe Supply for Customers	31,329	31,515	31,579	31,688	32,000	32,306
Customer Safe Supply Surplus/Shortage	-2,513	-4,175	-5,134	-6,137	-7,344	-10,864

Wichita County WID No. 2 provides irrigation water to users in Archer, Clay, and Wichita counties. The City of Wichita Falls and Wichita County WID No. 2 jointly provide water from Lake Kemp/Diversion system to the AEP steam electric power plant in Wilbarger County and the Dundee Fish Hatchery near Lake Diversion. For simplicity, the contracts for these customers and associated supplies are shown only on the WID. Based on this analysis, the needs for the Wichita County WID No. 2 are over 25,000 acre-feet per year in 2020 and increase to over 37,000 acre-feet per year by 2070.

Table 4-11
Projected Water Shortages for the Wichita County WID No. 2
-Values are in Acre-feet per Year-

	2020	2030	2040	2050	2060	2070
Total Firm Demand	49,518	49,518	49,518	49,518	49,518	49,518
Total Supplies	24,192	21,772	19,353	16,934	14,515	12,096
Supplies Less Current Customer Demand	-25,327	-27,746	-30,165	-32,584	-35,003	-37,422
Firm Need by Category	2020	2030	2040	2050	2060	2070
Irrigation	-21,426	-23,244	-25,062	-26,880	-28,698	-30,516
Livestock (Fish Hatchery)	-2,200	-2,200	-2,200	-2,200	-2,200	-2,200
Steam Electric Power	-1,701	-2,302	-2,903	-3,504	-4,105	-4,706
Total Firm Need	-25,327	-27,746	-30,165	-32,584	-35,003	-37,422

4.2.3 Summary of First-Tier Water Needs

For several water user groups, the total demands exceed the total developed supply starting in 2020. Most of the shortages are associated with reductions in surface water supplies for the major water providers or wholesale providers and contract limitations. Other shortages are due to limitations of available groundwater and increased mining demands. The evaluation of regional water supplies indicates that there is little fresh groundwater that could be further developed, and options for new surface water are limited in the western part of the region due to high salinity levels. The First-Tier water needs report provided by TWDB is provided in Appendix G. Further review of the region’s options and strategies to meet shortages is explored in more detail in Chapter 5 and the impacts of these strategies on water quality are discussed in Chapter 6.

4.3 Evaluation of Reliable Supply

While many water user groups were not identified with a water quantity shortage, several were found to have little to no supplies above the projected demands, and thus water reliability concerns.

The Region B Regional Water Planning Group recognized that these entities were likely to need to develop new supplies to provide a safe level of supply. To determine which entities may be impacted, a safe supply was defined as being able to meet the projected demands plus 20 percent of the demand. This was applied only to municipal and manufacturing water user groups. Using these criteria, twenty-six municipal and manufacturing water users were identified with safe supply shortages. Of these users, twenty-one are also shown to have firm supply shortages. Table 4-12 lists these users and the safe supply shortages over the planning horizon.

Table 4-12
Water Users with Safe Supply Shortages
-Values are in Acre-feet per Year-

	2020	2030	2040	2050	2060	2070
Archer City	-20	-14	-16	-21	-34	-69
Archer County MUD 1	-92	-90	-92	-93	-96	-106
Holliday	-36	-55	-65	-74	-83	-116
Lakeside City	0	0	0	0	0	-8
Scotland	-31	-91	-95	-102	-111	-135
Windthorst WSC	-100	-119	-131	-142	-159	-209
County-Other - Archer	-65	-42	-35	-33	-32	-32
Baylor County SUD	-26	-26	-25	-28	-29	-31
County-Other - Clay	-77	-82	-66	-58	-57	-57
Red River Authority	-40	-38	-57	-114	-156	-238
Crowell	0	0	0	-26	-39	-50
Quanah	0	0	0	-79	-115	-156
Manufacturing - Hardeman	0	-52	-52	-90	-107	-126
Bowie	-40	-138	-216	-310	-410	-509
Nocona Hills WSC	-8	-9	-9	-10	-12	-12
County-Other - Montague	-34	-32	-13	-13	-19	-25
Electra	-310	-344	-385	-432	-479	-587
Harrold WSC	-37	-42	-48	-53	-58	-73
Iowa Park	0	0	0	0	-62	-217
Sheppard AFB	-152	-204	-231	-262	-296	-408
Wichita Falls	-2,250	-3,574	-4,242	-4,873	-5,646	-7,868
Manufacturing - Wichita	-253	-321	-350	-380	-413	-513
Vernon	-26	-192	-233	-319	-391	-436
Manufacturing - Wilbarger	-192	-210	-210	-210	-210	-223
Olney	0	0	0	-34	-83	-179
County-Other - Young	-8	-10	-12	-13	-15	-16
Total	**-3,797**	**-5,685**	**-6,583**	**-7,769**	**-9,112**	**-12,399**

4.4 Effect of Water Quality on Supply

Water quality is a significant issue in Region B. Due to limited resources, some user groups are using water of impaired quality or having to install additional treatment systems to utilize existing sources. An implied assumption of the supply analysis is that the quality of existing water supplies is acceptable for the listed use. In other words, water supplies that are currently being used are assumed to continue to be available, regardless of the quality. Senate Bill 1 requires that water quality issues be considered when determining the availability of water during the planning period. For this report, evaluations of source water quality are generally confined to waters used for human consumption. The effect of water quality of Lake Kemp on agricultural use is also reviewed.

4.4.1 Municipal Water Systems with Existing or Potential Quality Concerns

To determine whether the quality of specific sources of supply imposes a potential limitation on their use, the quality of the major sources of supply was compared to current and proposed drinking water standards. Pursuant to the Federal Safe Drinking Water Act, the U.S. Environmental Protection Agency (EPA) has adopted maximum contaminant levels (MCLs) for a list of organic and inorganic contaminants of drinking water. This list constitutes the primary drinking water standards, and water used for human consumption is to comply with the MCLs established by this list.

The Texas Commission on Environmental Quality (TCEQ) identifies systems that are not compliant with current and proposed primary drinking water standards. This information was reviewed for water users in Region B. Compliance with secondary drinking water standards was not evaluated since the secondary standards do not have the same regulatory and public health implications. Also, compliance with the bacteriological standards (total coliform and fecal coliform) was not evaluated since violations of these standards, when they occur, are typically associated with operational techniques and not the quality of the raw water supply. The water systems in Region B that have existing or potential non-compliances are identified in Table 4-13, along with the parameter of concern.

Table 4-13
Water Systems Not Compliant with Primary Drinking Water Quality Standards

Water System	County	Water Source	CURRENT STANDARD NO_3 MCL = 10 mg/L
Northside WSC	Wilbarger	Seymour Aquifer	X
Red River Authority Hinds-Wildcat Water System	Wilbarger	Seymour Aquifer	X

The TCEQ records indicate that the only primary drinking water standard (other than bacteriological) currently exceeded by water users in Region B is the nitrate criterion. Two water users have water supplies that exceed the MCL for nitrate.

Nitrate Concerns

The nitrate MCL is 10 mg/L. Consumption of water with nitrate levels in excess of 10 mg/L by infants can cause methemoglobinemia or "blue baby syndrome", a potentially fatal condition. Additionally, pregnant women are urged not to drink water with a high concentration of nitrates because of the potential health effects on the unborn fetus.

In Region B, moderate to high nitrate levels are found in water from the Seymour Aquifer. These concentrations are partly attributed to agricultural activities in the area. Long-standing practices associated with fertilizing crops are believed to have caused an increase in nitrates in the groundwater. Not all water produced from the Seymour Aquifer has excessive nitrates, but the water users shown in Table 4-13 have historically exhibited nitrate concentrations above the MCL of 10 mg/L. Other users of Seymour water with high nitrates have implemented advanced treatment, such as the City of Vernon, and are not identified with water quality concerns. The Red River Authority indicated they are in the process of addressing the nitrate issues for the Hinds-Wildcat Water System.

Removal of nitrates requires advanced treatment, such as reverse osmosis or a comparable advanced membrane technique. Nitrates can also be reduced by blending the water with another water source with low nitrate levels, if such a source is available and otherwise of acceptable quality. The TCEQ currently is urging all water systems in the region using water with high nitrate levels to reduce the nitrate concentration by treatment, by blending, or by securing an alternate source of water. Most of the systems have complied with the standards through one of these means.

4.4.2 Salinity Concerns for Lake Kemp and Diversion Lake

Waters in the Wichita River Basin have historically exhibited high dissolved solids and chloride concentrations. Previous studies, dating back to 1957, have documented that the salt concentrations in the area significantly limit the use of these waters for municipal, industrial, and irrigation purposes.

The U.S. Army Corps of Engineers (USACE) determined that an average of over 3,600 tons per day of chlorides were being discharged to the Red River system from natural and man-made sources. A project, known as the Chloride Control Project, has been designed to reduce the amount of salt contamination from eight of the Red River Basin's natural salt sources; three of which lie within the Wichita River Basin. To date, only one of the proposed chloride control facilities has been constructed and is operational. This low-flow dam structure on the South Wichita River (within the Lake Kemp drainage basin) retains low flows that are high in salts, and diverts them via a pump station and pipeline to Truscott Brine Reservoir. Low-flow diversion dams are also planned for the Middle and North Wichita Rivers. When constructed, high chloride water that would normally flow to Lake Kemp and Lake Diversion would be diverted to Truscott Brine Reservoir.

Recent water quality data of the Lake Kemp/Diversion system indicate that chloride levels have reduced since completion of the first chloride control project, but they still limit the water use. The primary uses impacted by the lakes' salt content are potable water supplies and irrigation. Water quality criteria established pursuant to the Safe Drinking Water Act considers high salt content aesthetically undesirable, and is regulated under the secondary drinking water standards. Chloride, sulfate, and total dissolved solids concentrations are subject to the secondary standards. The TCEQ established criteria for these parameters that are somewhat higher than EPA criteria, and water systems in Texas are subject to the state criteria. Both the TCEQ and EPA standards and typical Lake Kemp levels for these parameters are presented in Table 4-14.

Table 4-14
Secondary Drinking Water Standards and Salinity Levels for Lake Kemp

Parameter	TCEQ Criteria	EPA Criteria	Lake Kemp Typical concentration[1]	Lake Kemp 2011-2014 concentrations[1]
Chloride (mg/L)	300	250	1,000 – 1,400	1,600-1,900
Sulfate (mg/L)	300	250	700 - 900	1,000-1,200
Total Dissolved Solids (mg/L)	1,000	500	2,700 – 3,600	4,300-5,100

[1]https://www80.tceq.texas.gov/SwqmisPublic/index.htm (typical is defined as 25th percentile to 75th percentile)

Following the drought of 2011, the water quality of Lake Kemp further deteriorated, and the water was determined to be unsuitable for irrigation use. TDS levels as shown in Table 4-14 increased significantly over typical concentrations. Water was not released from Lake Kemp-Diversion for irrigation use from 2012 through mid 2015. Wichita Falls constructed a reverse osmosis water treatment facility to treat water from the Lake Kemp-Diversion system. The drought drove the TDS concentrations up so high, the remaining water in Lake Kemp was unusable for the City, as the MF/RO plant could not treat this high TDS water. Therefore, the City abandoned the Lake Kemp supply and developed the emergency direct potable reuse project.

The salinity of irrigation water from Lake Kemp can also limit the crops to which it can be applied. There are several systems for classifying the salinity of waters that characterize the suitability of the water for various types of crops. One classification system developed by the U.S. Department of Agriculture (USDA) in 1954 identifies four classes of water, based on the chloride concentration of the water, and describes the suitability of each class for irrigation. The water in Lake Kemp and Diversion Lake is generally Class III - High Salinity Water (Chloride > 750 mg/L, but < 2,150 mg/L). Therefore, its use for irrigation is limited to plants with high salt tolerance. The USDA Plant Sciences Group has performed research on the salt tolerance of various herbaceous crops, and examples of salt tolerant crops include cotton, barley, sugar beet, Bermuda grass, and asparagus.

4.5 Summary of Needs

In Region B, water supply needs were identified for three different categories: quantity, quality, and reliability. As shown on Table 4-15, a total of 32 water user groups were identified with one or more of these need categories. Twenty-seven water user groups were identified with firm quantity needs. An additional five water user groups have projected safe supply shortages (reliability), and two municipal suppliers in Wilbarger County and two irrigation users were found to have water quality concerns.

Table 4-15
Water Users with Identified Needs (Firm and Safe)

Water User	Quantity	Quality	Reliability
Archer City	X		
Archer County MUD 1			X
Baylor County SUD			X
Bowie			X
County-Other - Archer			X
County-Other - Clay			X
County-Other - Montague			X
County-Other - Young	X		
Crowell			X
Electra	X		
Harrold WSC			X
Holliday	X		
Iowa Park	X		
Irrigation - Archer	X	X	
Irrigation - Wichita	X	X	
Lakeside City	X		
Manufacturing - Hardeman	X		
Manufacturing - Wichita	X		
Manufacturing - Wilbarger	X		
Mining - Archer	X		
Mining - Montague	X		
Nocona Hills WSC			X
Olney			X
Quanah			X
Red River Authority		X	X
Scotland	X		
Sheppard AFB			X
Steam Electric Power - Wichita	X		
Steam Electric Power - Wilbarger	X		
Vernon	X		
Wichita Falls	X		
Windthorst WSC	X		

4.6 Second-Tier Water Needs Analysis

The Second-Tier water needs analysis compares currently available supplies with demands after reductions from conservation and direct reuse. Conservation and direct reuse are both considered water management strategies and are discussed further in Chapter 5. The Second-Tier needs report by WUG is provided in Appendix G. Table 4-16 and Table 4-17 summarize the second-tiers needs for the Major Water Providers in Region B.

Table 4-16
Second-Tier Need for City of Wichita Falls

	2020	2030	2040	2050	2060	2070
Firm Need	1,227	-404	-1,352	-2,337	-3,492	-6,961
Water Conservation	169	340	512	686	871	884
Second-Tier Need	1,396	-64	-840	-1,651	-2,621	-6,077

Table 4-17
Second-Tier Need for Wichita County WID No. 2

	2020	2030	2040	2050	2060	2070
Firm Need	-25,327	-27,746	-30,165	-32,584	-35,003	-37,422
Water Conservation	830	2,292	3,656	7,988	10,026	12,850
Second-Tier Need	-24,497	-25,454	-26,509	-24,596	-24,977	-24,572

LIST OF REFERENCES

Allison, L. E., et al, "Diagnosis and Improvements of Saline and Alkali Soils", United States Salinity Laboratory, United States Department of Agriculture, 1953.

Crops and Ornamentals Salt Tolerance Database, http://www.ussl.ars.usda.gov/saltoler.htm, February 2000.

Maas, E. V., "Physiological Response of Plants to Chloride", Chloride and Crop Production, American Society of Agronomy Annual Meeting, Las Vegas, NV, December 1984.

CHAPTER 5

WATER MANAGEMENT STRATEGIES

2021 FINAL PLAN

REGION B

OCTOBER 2020

CHAPTER 5

WATER MANAGEMENT STRATEGIES
2021 FINAL PLAN
REGION B

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.

This chapter is divided into five main sections. Section 5.1 discusses the types of potentially feasible water management strategies. Section 5.2 discusses the process used to develop the strategies, and the factors considered in evaluating the strategies. Section 5.3 discusses the water conservation strategies that were considered and recommended for users in Region B. This includes the identification and evaluation for municipal, irrigation and mining conservation measures. Section 5.4 presents the recommended water management strategies for the two major water providers in Region B. Section 5.5 addresses the recommended strategies for each water user group with identified shortages and summarizes the water management plans by county.

Over the planning period there may be additional water users that will need to upgrade their water supply systems or develop new supplies but are not specifically identified in this plan. For aggregated water users, such as "County-Other", the identification of needs can be challenging due to the nature of the data evaluation. It is the intent of this plan to include all water systems that may demonstrate a need for water supply. This includes established water providers and new water supply corporations formed by individual users that may need to band together to provide a reliable water supply. In addition, Region B considers water supply projects that do not impact other water users but are needed to meet demands or to meet regulatory requirements consistent with the regional plan even though not specifically recommended in the plan.

This plan assumes that management strategies to meet any identified shortages are employed or implemented by the respective water user. The Region B Water Planning Group (RWPG) does not take responsibility in planning or implementing the strategies.

5.1 Evaluation of Potentially Feasible Strategies

This section provides a review of the types of water management strategies (WMS) considered for Region B and the approach for identifying the potentially feasible water management strategies for water users with shortages. Once a list of potential feasible strategies has been identified, the most feasible strategies are recommended for implementation. Alternative strategies can also be identified in case the recommended strategies become unfeasible. These strategies are discussed in more detail in later sections. This section identifies the potentially feasible strategies for water users that were found to have a projected need in Chapter 4. All potentially feasible strategies were evaluated under drought of record conditions as noted in the evaluations.

5.1.1 Identification of Potentially Feasible Strategies

In accordance with TWDB rules, the Region B RWPG has adopted a standard procedure for identifying potentially feasible strategies. The process for identifying potentially feasible water management strategies was presented at the January 10, 2018 RWPG meeting. There were no public comments and the RWPG approved the methodology. A copy of the presentation of the methodology is presented in Attachment 5-1. This procedure classifies strategies using the TWDB's standard categories developed for regional water planning. These strategy categories include:

- Water Conservation
- Drought Management Measures
- Wastewater Reuse
- Management and/or Expanded Use of Existing Supplies
    - System Operation
    - Conjunctive Use of Groundwater and Surface Water
    - Reallocation of Reservoir Storage
    - Voluntary Redistribution of Water Resources

  - Voluntary Subordination of Existing Water Rights
  - Yield Enhancement
  - Water Quality Improvement
- New Supply Development
  - Surface Water Resources
  - Groundwater Resources
  - Brush Control
  - Desalination
  - Water Right Cancellation
  - Aquifer Storage and Recovery (ASR)
- Interbasin Transfers
- Emergency Transfers of Water

One of the purposes of this chapter is to provide a big picture discussion on the various strategy types that were identified to potentially reduce the identified shortages, the applicability of these strategies for users in Region B, and provide documentation of the strategy types that are not appropriate for Region B.

Potentially Feasible Strategies not appropriate for Region B

While each of these strategy types were considered by the RWPG, not all were determined as viable options for addressing shortages in the region. Region B does not consider drought management as an appropriate strategy to meet long-term growth in demands. This strategy is considered a temporary strategy to conserve available water supplies during times of drought or emergencies and acts as means to 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 B is supportive of the development and use of these plans during periods of drought or emergency water needs.

The RWPG also does not consider water right cancellation to be an appropriate strategy for Region B. Instead, Region B recommends that a water right holder consider selling water under their existing water right to the willing buyer. Emergency transfers of water are considered in Chapter 7. Similar to drought management, this strategy is an emergency response to drought or loss of water supplies and is not appropriate for long-term growth in demands.

Voluntary subordination is not appropriate for Region B since most of the water rights held in the region are reliable based on the priority in the Water Availability Models. It should also be noted that most of the major water rights held in reservoirs in the basin are owned by the MWPs that coordinate water diversions from Lake Kemp.

Potential Yield Enhancement projects, which could include dredging or evaporation suppression, have not been shown to be cost effective for water supply purposes. Wichita Falls did conduct a pilot study on evaporation suppression during the drought and the results indicated potential reductions in evaporation, however the study was unable to state these savings with a high level of confidence.

Other strategies considered but dismissed as not appropriate for Region B are aquifer storage and recovery (ASR) and reallocation of reservoir storage. For the purpose of evaluating ASR, the RWPG defined a significant need as greater than 4,000 acre-feet during any decade of the planning period. This threshold was identified by developing a histogram of needs and presenting those to the RWPG. Three water user groups meet this criterion (City of Wichita Falls, Irrigation - Wichita County, Steam Electric Power – Wilbarger County). The key components of ASR are the availability of suitable geologic formation for storage of the water, available water source, and the infrastructure to place the water into the aquifer and then recover the water when needed. ASR was not considered for any of these three entities in Region B due to the lack of suitable geologic formations in close proximity to the need. The planning group also expressed support for managed aquifer recharge (MAR) where appropriate to restore groundwater levels. At this time, no project sponsors have identified an ASR or MAR water supply project in Region B.

The opportunities for reallocation of reservoir storage from non-water supply to water supply is very limited in Region B (i.e. flood control or hydropower to water supply). Lake Kemp is the only surface water supply in Region B with a dedicated flood control storage pool. There are no hydropower lakes in the region. Lake Kemp has been studied as a potential source for reallocation, and studies have indicated reallocation of flood storage would not result in additional reliable supply. As such, this strategy type is not considered appropriate for Region B.

Potentially Feasible Water Management Strategies for Region B

The strategy types (and associated subcategories) that were determined as potentially feasible strategies for entities within Region B are: 1) water conservation 2) wastewater reuse 3) expanded use of existing supplies (system operation, conjunctive use, voluntary redistribution, and water quality improvements), and 4) new supply development (new surface water, new groundwater, brush control, and desalination).

A brief discussion of each of these strategy types and the specific application to the users in Region B is presented in the following subsections.

5.1.2 Water Conservation

Water conservation is defined as methods and practices that 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. Water conservation is typically viewed as long-term changes in water use that are incorporated into daily activities.

Water conservation is a valued water management strategy in Region B because it helps extend the water resources in the region. It is specifically recommended for all municipal and irrigation water users with a shortage or need as shown in Chapter 4 and recommended for all other municipal and irrigation users, whether the user has a defined shortage or not.

It is recommended for all mining users that are shown to have a shortage, and it is encouraged for manufacturing, and steam electric users.

5.1.3 Wastewater Reuse

Wastewater reuse utilizes treated wastewater effluent as either a replacement for a potable water supply (direct reuse) or utilizes treated wastewater that has been returned to a water supply resource (indirect reuse). Currently, the majority of reuse in Region B is through the City of Wichita Falls indirect potable water project via the bed and banks of Lake Arrowhead, which can supply up to 8 million gallons per day (MGD). The City of Wichita Falls also provides 0.25 MGD as cooling water to the Vitro facility for manufacturing of plate glass. The remaining reuse supplies are limited to municipal irrigation and/or use at the wastewater treatment facilities; however, the City of Bowie has sold nearly all of its wastewater effluent for mining purposes in the recent past. Other entities may be looking to develop reuse projects in the near future; however, these projects are not anticipated to be online by 2020.

5.1.4 Expanded Use of Existing Supplies

Expanded use of existing supplies includes seven subcategories ranging from selling developed water that is not currently used to enhancing existing supplies through operations, storage, treatment or other means. In Region B, four of the seven subcategories were determined potentially feasible. These include system operations, conjunctive use of groundwater and surface water, water quality improvements and voluntary transfer (sales or contracts for developed water).

System Operation

System operation involves the management of two or more water supplies to maximize the supplies from these sources, which can result in increased water supplies. Wichita Falls owns and operates multiple surface water systems that do not benefit from system operation. In previous planning, system operation analyses of these systems found minimal increases in water supplies from system operation. While this strategy is employed by

Wichita Falls and supported by Region B, this strategy type does not provide additional supply in Region B.

Conjunctive Use of Groundwater and Surface Water

Conjunctive use is the operation of multiple sources of water to optimize the water resources for additional supply. In the past, Wichita Falls considered the development of new groundwater sources that could operate conjunctively with existing surface water sources. This would help reduce evaporative losses associated with the surface water reservoirs, while still meeting demands with groundwater when less surface water is available. This strategy is considered potentially feasible for entities with both surface water and groundwater.

Water Quality Improvements

Water quality improvements allow for the use of impaired water for municipal or other uses. In Region B, there are considerable amounts of brackish surface water and groundwater. Water quality improvement for these sources are typically accomplished through desalination. This discussion is under the strategy type “Desalination”. This strategy type would apply to treatment of other water quality parameters.

In addition to the treatment of existing sources, the Corps of Engineers has a Red River Chloride Control Project to control natural chloride brine emissions at ten major source areas to improve water quality. The Wichita Basin portion was completed May 2004. It is a federally funded and directed project.

Voluntary Redistribution

Voluntary redistribution is transfer of existing water supplies from one user to another through sales, leases, contracts, options, subordination or other similar types of agreements. Typically, the entity providing the water has determined that it does not need the water for the duration of the transfer. The transfer of water could be for a set period of years or a permanent transfer. Redistribution of water makes use of existing resources and provides a more immediate source of water. In Region B, there is little to no existing developed water that is available for redistribution without the development of additional strategies.

This strategy is used to represent sales and contracts between a water provider and its customers. It can include current contractual obligations and potential future customers.

5.1.5 New Supply Development

New supply development utilizes water that is not currently being used or generates new supplies through aquifer storage and recovery of water that otherwise would not have been available. This strategy type typically includes substantial infrastructure improvements to develop the new source, transport the water and, if needed, treat the water for its ultimate end use. The subcategories for this strategy type include new surface water development, new groundwater development, and brush control.

Surface Water Development

The opportunity for new surface water development is limited in Region B with many of the suitable locations already developed. The Water Availability Model for the Red River Basin shows water available for new appropriations in the Little Wichita River Basin. There are existing water rights that are currently not being used but could potentially be further developed such as run-of-river supplies from Lake Kemp, however these supplies would need advanced treatment for municipal use. Lake Ringgold has been a recommended strategy for Wichita Falls in past plans and remains a recommended strategy for Region B in this plan.

Groundwater Development

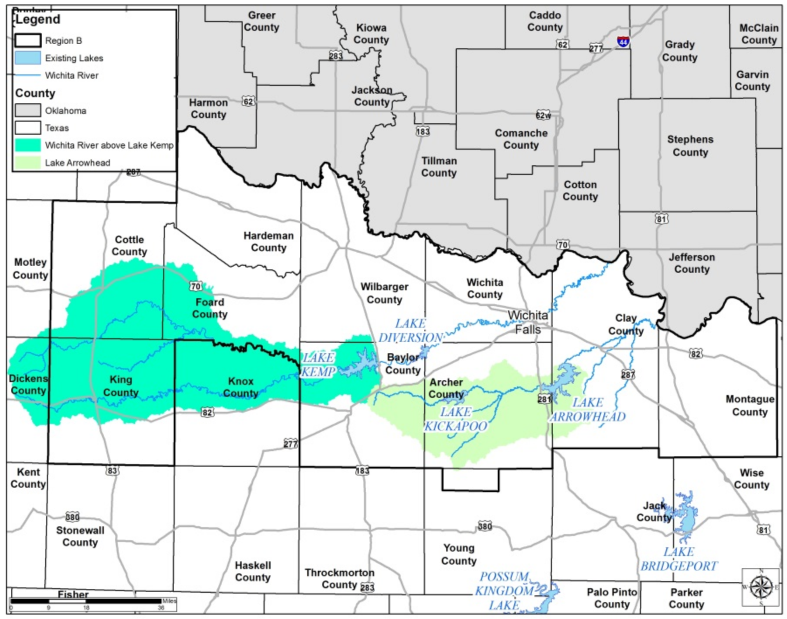
Groundwater accounts for approximately 50 percent of the total water use in Region B. The Blaine Aquifer in Cottle and Foard County is shown to have available supplies, however, the challenges with using water from the Blaine Aquifer are that the water tends to be brackish and the source is not near areas with need. The remaining supply from the Seymour Aquifer in Foard and Hardeman represents where the Modeled Available Groundwater (MAG) exceeds historical use and the Region B Water Planning Group indicated they will not allocate this as a current or strategy supply. Table 5-1 shows the amount of groundwater that is available for new groundwater development by county and by aquifer.

Table 5-1 Available Groundwater Supplies for Strategies

Aquifer	County	2020	2030	2040	2050	2060	2070
Blaine	Cottle	11,151	8,006	8,041	8,013	8,048	8,016
Blaine	Foard	6,559	6,541	6,559	6,541	6,559	6,541
Blaine	Hardeman	1,968	1,945	1,968	1,945	1,968	1,945
Blaine	King	220	220	220	220	220	220
Cross Timbers	Archer	52	49	52	52	54	54
Cross Timbers	Baylor	30	30	30	30	30	30
Cross Timbers	Clay	166	16	166	266	366	366
Cross Timbers	Montague	874	874	1,874	2,174	2,074	2,074
Cross Timbers	Wichita	181	181	181	181	181	181
Cross Timbers	Young	656	646	639	631	623	615
Other	Cottle	186	186	186	286	286	286
Other	Foard	188	188	188	188	189	189
Other	Hardeman	9	9	9	9	9	9
Other	King	128	177	219	257	289	289
Seymour	Archer	35	35	35	35	35	35
Seymour	Baylor	976	1,091	738	492	368	691
Seymour	Clay	132	122	157	157	157	157
Seymour	Foard	8,569	1,617	2,061	4,738	4,487	615
Seymour	Hardeman	13,844	6,506	12,351	10,986	13,468	26,334
Seymour	Wichita	1,036	1,037	1,036	1,045	1,050	1,050
Seymour	Wilbarger	725	725	725	725	725	725
Trinity	Montague	2,648	2,629	2,633	2,612	2,615	2,597
Total		**50,333**	**32,830**	**40,068**	**41,583**	**43,801**	**53,019**

1. This is the amount of groundwater that is available for strategies.

Brush Control



In 1985, the Texas Legislature authorized the Texas State Soil and Water Conservation Board (TSSWCB) to conduct a program for the "selective control, removal, or reduction of brush species that consume water to a degree that is detrimental to water conservation." In 1999 the TSSWCB began the Brush Control Program. In 2011, the 82nd legislature replaced the Brush Control Program with the Water Supply Enhancement Program (WSEP). The WSEP's purpose is to increase available surface and groundwater supplies through the selective control of brush species that are detrimental to water conservation.

WSEP considers priority watersheds across the state, the need for conservation within the territory of a proposed projection based on the State Water Plan and if the Regional Water Planning Group has identified brush control as a strategy in the State Water Plan as part of their competitive grant, cost sharing program. At the time of publication of this plan the WSEP is not a funded program.

Feasibility studies have been conducted for two watersheds in Region B: Wichita River upstream of Lake Kemp, and Little Wichita River Watershed upstream of Lake Arrowhead. These studies indicate there is potential for water loss reduction from brush, but these losses have been difficult to quantify during periods of drought. Brush control will be considered a potentially feasible strategy for Region B.

Desalination

Desalination is the removal of excess salts from either surface water or groundwater for beneficial use. In Region B, most of the fresh groundwater supplies have been developed and are currently being used. The region has brackish water that potentially could be desalinated and used for municipal use. This process tends to require considerable energy and is more costly than conventional treatment. It also produces a waste stream that can vary from less than 20 percent to nearly 50 percent of the raw water, depending upon the level of salts. Since this strategy is fairly expensive, it is not an economically viable option for agricultural use. This strategy is considered for the municipal development of brackish water. Seawater desalination was not selected as a recommended strategy for any entity given the region's proximity to the Gulf of Mexico is over 300 miles away.

5.1.6 Summary of Potentially Feasible Strategies

There are four potentially feasible water management strategies that were identified for water users and major water providers in Region B. These strategies include a wide assortment of strategy types, which were carefully reviewed for entities with identified needs. Strategies were only considered potentially feasible if the strategy:

- Is appropriate for regional planning;
- Utilizes proven technology;
- Has an identifiable sponsor;
- Could meet the intended purpose for the end user, considering water quality, economics, geographic constraints, and others, as appropriate; and
- Meets existing regulations.

A list of the potentially feasible water management strategies considered for Region B is included in Attachment 5-2 at the end of this chapter. The process for strategy development and evaluation is presented in the following sections.

5.2 Strategy Development and Evaluation

Water management strategies were developed for water user groups to meet projected needs in the context of their current supply sources, previous supply studies and available supply within the region. Where site-specific data were available, this information was used. When specific well fields could not be identified, assumptions regarding well capacity, depth of well and associated costs were developed based on county and aquifer. The primary new surface water supplies are associated with the use of unappropriated water in the Little Wichita River Basin.

Water transmission lines were assumed to take the shortest route, following existing highways or roads where possible. Profiles were developed using GIS mapping software or USGS topographic maps. Pipes were sized to deliver peak-day flows within reasonable pressure and velocity ranges. Water losses associated with transmission systems were assumed to be negligible. Strategies identified as being online in 2020 are expected to be constructed and delivering water by January 5, 2023.

Municipal and manufacturing strategies were developed to provide water of sufficient quantity and quality that is acceptable for its end use. Water quality issues affect water use options and treatment requirements. For the evaluations of the strategies, it was assumed that the final water product would meet existing state water quality requirements for the specified use. For example, a strategy that provided water for municipal supply would meet existing drinking water standards, while water used for mining may have a lower quality. If advanced water treatment was required, associated water losses were assumed to be 25 percent of the treated water. For some strategies, only a portion of the water may require treatment and losses were accounted for accordingly.

5.2.1 Strategy Evaluation Criteria

The consideration and selection of water management strategies for water user groups with needs followed TWDB guidelines and were conducted in open meetings with the Region B RWPG. In accordance with state guidance, the potentially feasible strategies were evaluated with respect to:

- Quantity, reliability and cost;

- Environmental factors, including effects on environmental water shortages, wildlife habitat and cultural resources;
- Impacts on water resources, such as playas and other water management strategies;
- Impacts on agriculture and natural resources; and
- Other relevant factors.

Other relevant factors include regulatory requirements, political and local issues, amount of time required to implement the strategy, recreational impacts of the strategy, third party impacts, and other socio-economic benefits or impacts.

The definition of quantity is the amount of water the strategy would provide to the respective user group in acre-feet per year. This amount is considered with respect to the user's short-term and long-term shortages. Reliability is an assessment of the availability of the specified water quantity to the user over time. If the quantity of water is available to the user all the time, then the strategy has a high reliability. If the quantity of water is contingent on other factors, reliability will be lower.

The assessment of cost for each strategy is expressed in dollars per acre-foot per year for water delivered and treated for the end user requirements. Calculations of these costs follow the Texas Water Development Board's guidelines for cost considerations and identify capital and annual costs by decade. Project capital costs are based on September 2018 price levels and include construction costs, engineering, land acquisition, mitigation, right-of-way, contingencies, and other project costs associated with the respective strategy. Annual costs include power costs associated with transmission, water treatment costs, water purchase (if applicable), operation and maintenance, and other project-specific costs. Debt service for capital improvements was calculated over 20 years (40 years for reservoir projects) at a 3.5 percent interest rate. Costs were not assessed for fulfillment of existing contracts if no new infrastructure is needed.

Potential impacts to sensitive environmental factors were considered for each strategy. Sensitive environmental factors may include wetlands, threatened and endangered species, unique wildlife habitats, and cultural resources. In most cases, a detailed evaluation could not be completed because previous studies have not been conducted or the specific location of the new source (such as a groundwater well field) was not identified. Therefore, a more detailed environmental assessment will be required before a strategy is implemented.

The impact on water resources considers the effects of the strategy on water quantity, quality, and use of the water resource. A water management strategy may have a positive or negative effect on a water resource. This review also evaluated whether the strategy would impact the water quantity and quality of other water management strategies identified.

A water management strategy could potentially impact agricultural production or local natural resources. Impacts to agriculture may include reduction in agricultural acreage, reduced water supply for irrigation, or impacts to water quality as it affects crop production. Various strategies may actually improve water quality, while others may have a negative impact. The impacts to natural resources may consider inundation of parklands, impacts to exploitable natural resources (such as mining), recreational use of a natural resource, and other strategy-specific factors.

Infrastructure cost estimates for Region B strategies may be found in Appendix C. Appendix D includes a Strategy Evaluation Matrix and Quantified Environmental Impact Matrix.

5.3 Water Conservation

Water conservation is defined by Texas Water Code §11.002(8) as "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." Water conservation measures are long-term, permanent strategies to reduce water use that apply to all categories of water use and supply sources.

Title 31 of the Texas Administrative Code (31 TAC) §357.34 (g) requires the 2021 Plan to consolidate and present recommendations that may include Best Management Practices (BMPs) appropriate for the region. Some of the demand projections developed for SB1 Planning (Chapter 2) incorporate an expected level of conservation to be implemented over the planning period. Further, for WUGs with identified water needs, conservation WMSs must be included as part of the WUGs list of strategies to meet shortages; or a summary of reasons must be provided in the plan for not including conservation WMSs.

Section 5.3.1 identifies WUGs and WWPs that are required to have conservation plans and plan requirements, provides a review of water conservation plans and practices in Region B. Section 5.3.2 summarizes water conservation included in the demand projections for each water use category. This will be followed by a discussion in Section 5.3.3 of WUGs with needs and recommendations for BMPs which could be implemented by WUGs with needs and a summary provided in Section 5.3.4.

5.3.1 WUG and WWP Conservation Requirements

The following types of entities are required to develop and submit water conservation plans to the TWDB, the TCEQ, and/or the RWPG, as noted.

- Any entity **applying for a new or an amended water right** is **required to prepare and implement a water conservation plan (WCP)** and **submit it to the TCEQ** with the application in accordance with 30 TAC §295.9. The entity may or may not be required to submit this plan to the RWPG depending on the requirements of rules.
- Any entity **holding an existing permit**, certified filing, or certificate of adjudication **for the appropriation of surface water in the amount of 1,000 acre-feet a year or more for municipal, industrial, and other non-irrigation uses** is required to develop, submit, and implement a water conservation plan (30 TAC §288.30). The plan must be submitted to the TCEQ and the RWPG.
- Any entity **holding an existing permit**, certified filing, or certificate of adjudication **for the appropriation of surface water in the amount of 10,000**

acre-feet per year or more for irrigation uses is required to develop, submit, and implement a water conservation plan. (30 TAC §288.30). The plan must be submitted to the TCEQ and the RWPG.

- A **public water system providing potable water service to 3,300 or more connections** is **required to develop a water conservation plan** and submit the plan to the Executive Director of the Texas Water Development Board. (Texas Water Code §13.146)
- Entities that have a financial obligation with TWDB greater than $500,000 are required to submit a water conservation plan.
- Each public water supplier is required to update and submit a Water Conservation Plan (WCP) to the Texas Commission on Environmental Quality (TCEQ) every five years in accordance with 30 TAC §288.2. These plans are to document coordination with the regional water planning group.
- A wholesale water provider shall review and update its water conservation plan every five years to coincide with the regional water planning group. (30 TAC 288.5)

The entities in Region B that are required to develop water conservation plans and submit them to the regional water planning group are identified in Table 5-2.

Table 5-2 Water Users and Types Required to Develop Implement, and Submit Water Conservation Plans

Entity	WUG	3,300 Connections or More	Non-Irrigation Water Right of 1,000 ac-ft/yr or More				Irrigation Water Right of 10,000 ac-ft/yr or More	Wholesale Water Provider
			Municipal/ Domestic	Industrial	Mining	Other		
City of Archer City	Yes	No	•					•
City of Bowie	Yes	No[1]	•	•				•
City of Burkburnett	Yes	Yes						
City of Henrietta	Yes	No	•					
City of Iowa Park	Yes	Yes	•					•
City of Olney	Yes	No	•					
City of Vernon	Yes	Yes						•
City of Wichita Falls	Yes	Yes	•	•	•	•	•	•
Greenbelt Municipal and Industrial Water Authority[3]	No	Yes	•					•
North Montague County Water Supply District[2]	No	No	•					•
Red River Authority of Texas	Yes	Yes	•			•		
Wichita County WID No. 2	No		•	•	•	•	•	•

1. As of July 2019, TCEQ records show that Bowie has 3,234 connections.
2. Per legislation from the State of Texas, this District will be dissolved by the end of 2019 and the water rights will be transferred to the City of Nocona.
3. Office of Greenbelt MIWA is in Donley County, however, several cities/water systems located in Region B buy water from this entity.

Requirements vary for each type of water supply entity. A summary of water conservation plan requirements by type of water use is provided below.

Municipal/Public Water Supply Conservation Plan Requirements

At a minimum each plan must include:

- Utility Profile that describes the entity, water system and water use data.
- Record management system that is capable of recording water use by different types of users.
- Quantified five-year and ten-year water savings goals.
- Metering device with a 5 percent accuracy to measure the amount of water diverted from the source of supply.

- A program for universal metering (customers and public uses); and a meter maintenance program.
- Measures to determine and control water loss.
- A program of continuing public education and information regarding water conservation.
- A non-promotional water rate structure.
- Reservoir operations plan if appropriate.
- Means of implementation and enforcement.
- Documentation of coordination with regional planning.

If a public water supplier serves over 5,000 people, they are additionally required to have a conservation-oriented rate structure and a program of leak detection, repair, and water loss accounting for the water transmission, delivery, and distribution system.

Industrial or Mining Water Conservation Plan Requirements

At a minimum, each plan must include the following elements or an explanation of why the element is not included:

- Description of the source of water and the water use in production, estimates of water consumed, and estimates of discharge.
- Specific quantifiable goals for 5-year and 10-year water savings and the basis for the goals.
- Description of devices or methods used to measure water use within 5 percent accuracy.
- Leak detection, repair, and an accounting of water loss.
- Application of state-of-the-art equipment or process modifications to improve water conservation efficiency.
- Other water conservation practices that will enable the water user to achieve the stated goals.
- Update the plan to coincide with the regional water planning group.

Agricultural Water Conservation Plan Requirements

At a minimum, each plan must include the following elements or an explanation of why the element is not included:

- For agricultural users other than irrigation, the requirements are essentially the same as those for industrial or mining water conservation plans.
- For individual irrigation users the requirements include:
    - Description of irrigation processes, methods, and crops.
    - Water measurement devices within 5 percent accuracy.
    - Specific 5-year and 10-year goals.
    - Identification and implementation of water conserving irrigation equipment.
    - Leak detection and control of water losses.
    - Irrigation scheduling to determine timing and volume of irrigation water.
    - Land improvements to improve irrigation efficiency
    - Tailwater recovery and other conservation practices.
- For systems providing irrigation water to multiple users the requirements include:
    - System profile describing the structural facilities, management practices, and user profile.
    - Specific 5-year and 10-year conservation goals.
    - Description of devices or practices used to measure water diverted from source(s).
    - Monitoring and records management to assess deliveries, sales, and losses.
    - Leak detection and water loss control program.
    - A program to assist customers with implementing water conservation plans and/or measures.
    - Record of plan adoption and documentation of coordination with regional water planning.

Water Conservation Plans for Wholesale Water Providers

The requirements of conservation plans for wholesale water providers (WWPs) are essentially the same as those for public water systems except that WWPs are required to include provisions in contracts with individual water users requiring them to develop and implement water conservation plans consistent with the goals of the WWP. In addition, the WWP is required to coordinate with the regional water planning group.

5.3.2 Water Conservation Included in the Demand Projections

The adopted water demands included in Chapter 2 incorporate some “built-in” water conservation for municipal demands. The following sections describe any water conservation efforts that are already included in the demand projections.

Municipal Demands

Projected water demands are based on water usage during the base planning year, which was the most recent very dry year. For most Region B WUGs, the base planning year is 2011. However, the per capita water use projected for future years is estimated to be less than the per capita water usage during the base year. The assumed reductions in per capita water use are the result of the implementation of the State Water-Efficiency Plumbing Act. Among other things, the Plumbing Act specifies that only water-efficient fixtures can be sold in the State of Texas. Savings occur because all new construction must use water-efficient fixtures, and other fixtures will be replaced at a fairly steady rate.

For example, the base year for the City of Wichita Falls was 2011 where a rate of 153 gallons per capita per day (GPCD) was estimated. However, the projected 2020 population and water demand presented in Chapter 2 are 104,830 people and 16,873 ac-ft/yr, respectively, for a calculated usage of 143.7 GPCD. The difference between 153 and 143.7 (9.3 GPCD) multiplied by the projected 2020 population is the amount of built-in conservation assumed for the City of Wichita Falls. This volume of conservation can be termed “Basic Conservation.” No future costs are included in the plan for this demand reduction. For the entire Region B, the Plumbing Act results in about a seven percent reduction in municipal water use (4,816 acre-feet per year) by year 2070.

Manufacturing Demands

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 water demands from 2020 to 2030, based on documented, planned new facilities. However, the policy holds projected manufacturing water demands constant at the 2030 level throughout the rest of the planning period (2040-2070).

Mining Demands

The mining demands do not specifically include a level of basic conservation. Opportunities for advanced conservation for mining are addressed in section 5.3.3.

Livestock Demands

Most of the livestock demand in Region B is for free-range livestock. Region B encourages individual ranchers to adopt practices that prevent the waste of water for livestock. However, savings that results from these practices will be small and difficult to quantify. Therefore, livestock water conservation is not included in the demand projections and is not considered to provide an opportunity for advanced conservation.

Irrigation Demands

Based on the TWDB projections, irrigation demands are expected to remain constant throughout the planning cycle. The irrigation demands do not specifically include a level of basic conservation. Opportunities for advanced conservation are described in Section 5.3.3.

Steam Electric Demands

Demands for steam electric power were developed on a state-wide basis and these demands assume that long-term power needs will be met with more water efficient facilities, and that the mixture of generating facilities includes wind and solar, which do not require cooling water. However, the steam electric demands for Region B do not include a component of Basic Conservation. Opportunities for advanced conservation are described in Section 5.3.3.

The volume of Basic Conservation included for each water use category is summarized in Table 5-3.

Table 5-3 Basic Conservation Included in Demand Projections (ac-ft/yr)

Water Use Category	2020	2030	2040	2050	2060	2070
Municipal	2,136	3,232	4,161	4,520	4,753	4,816
Manufacturing	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Livestock	0	0	0	0	0	0
Irrigation	0	0	0	0	0	0
Steam Electric	0	0	0	0	0	0
Total	**2,136**	**3,232**	**4,161**	**4,520**	**4,753**	**4,816**

5.3.3 Water Conservation Strategies for Region B

Water conservation strategies must be considered for all water users with a firm need prior to additional water management strategies. In Region B, this includes municipal, manufacturing, mining, agricultural water, and steam electric power users. Water conservation strategies will help address the needs through adoption of Advanced Conservation strategies. The water users with needs (firm or safe supply) are identified in Table 5-4.

Conservation strategies to reduce industrial (manufacturing, mining, and steam electric power) water use are typically industry and process-specific and cannot be specified to meet county-wide needs. The region recommends that industrial water users be encouraged to develop and implement site-specific water conservation practices. Wastewater reuse is a more general strategy that can be utilized by various industries for process water, and this strategy will be considered where appropriate.

For municipal and irrigation users, additional conservation savings can potentially be achieved in the region through the implementation of conservation best management practices (BMPs). These additional conservation measures were considered for all municipal water user groups in Region B with a projected need.

Table 5-4 WUGs with Needs

WUG	County
Archer City	Archer
Archer County MUD 1	Archer
Holliday	Archer
Lakeside City	Archer
Scotland	Archer
Windthorst WSC	Archer
County-Other	Archer
Manufacturing	Archer
Mining	Archer
Irrigation	Archer
Baylor County SUD	Baylor
County-Other	Clay
Red River Authority of Texas	Clay
Windthorst WSC	Clay
Crowell	Foard
Quanah	Hardeman
Red River Authority of Texas	Hardeman
County-Other	Montague
Manufacturing	Hardeman
Mining	Montague
Bowie	Montague
Mining	Montague
Noconoa Hills WSC	Montague
Electra	Wichita
Harrold WSC	Wichita
Iowa Park	Wichita
Sheppard Air Force Base	Wichita
Wichita Falls	Wichita
Manufacturing	Wichita
Steam Electric Power	Wichita
Irrigation	Wichita
Harrold WSC	Wilbarger
Vernon	Wilbarger
Manufacturing	Wilbarger
Steam Electric Power	Wilbarger
County-Other	Young
Olney	Young

Although water conservation and drought management have proven to be effective strategies in Region B, the RWPG believes that water conservation should not be relied upon exclusively for meeting future needs. The region will need to develop additional surface water, groundwater, and alternative supplies to meet future needs. However, each entity that is considering development of a new water supply should monitor on-going conservation activities to determine if conservation can delay or eliminate the need for a new water supply project.

The RWPG recognizes that it has no authority to implement, enforce or regulate water conservation and drought management practices. The water conservation practices described in this chapter and elsewhere in this plan are intended only as guidelines. Water conservation strategies determined and implemented by municipalities, water providers, industries or other water users supersede the recommendations in this plan and are consistent with this plan. It is further recognized that House Bill (HB) 807 requires the RWPG to "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 regional water planning area." The information in the sections below address this planning requirement.

Municipal Conservation

Both the water conservation plans and water loss audit reports for water suppliers in Region B were reviewed to help identify appropriate municipal water conservation measures and GPCD goals for each decade.

Since 2003, retail public water utilities have been required to complete and submit a water loss audit form to the TWDB every five years. The third round of water loss audit reports was submitted to the TWDB by May 1, 2016. The next predetermined scheduled audit is for the year 2020 with audit reports due to the TWDB by May 1, 2021. The TWDB compiles data from these reports. 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 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.

Eight (8) water providers in Region B have submitted water loss audits since 2012. Based on these reports, the six-year average (2012 to 2017) percentage of real water loss for Region B is approximately 15 percent. For the water suppliers that fall under the water supply corporation category, there may be few cost-effective options in reducing water loss.

Water Quantity, Reliability and Cost

The water savings associated with municipal conservation vary depending on the potential of the entity's customers to reduce water use. For most water users in Region B, water that is conserved (i.e., not consumed) will further protect the natural resources for future use. The reliability is moderate because this strategy relies on actions of others (customers) and the willingness to change daily behaviors. The suite of recommended strategies focuses on the actions of the water provider, which have shown to be successful in reducing water consumption. The costs are low to moderate for larger entities and high for smaller entities. Much of the higher costs are associated with the leak detection and repair strategy. For Vernon, the leak detection and repair strategy includes repair/replacement of raw water lines from current water sources (Odell-Winston wellfield pipeline), which were found to have significant water loss. It is assumed that the pipeline would be replaced in the decade starting with the year 2030.

For smaller entities, major infrastructure replacement associated with the leak detection and repair strategy may not be cost effective. Other methods may include a high efficiency toilet rebate program, supplying showerhead/aerator kits, or providing home water reports. The Municipal Water Conservation Planning Tool (developed for the TWDB) indicates that these three conservation methods have an average cost of $400/ac-ft of water saved to implement. The actual cost vary by +/-25 percent depending on the specific conservation methods used. However, $400 per acre-foot for municipal conservation was assumed in this plan. Table 5-5 shows the total water savings by provider for each decade along with the GPCD baseline and GPCD goal for each decade and Table 5-6 shows the associated costs for each decade.

Environmental Factors

Potential environmental impacts associated with municipal conservation should be neutral to positive. Reductions in water use will preserve water for other uses, including potential environmental purposes.

Impacts on Water Resources and Other Water Management Strategies

Impacts to natural resources should be neutral to positive. Conserved water by cities would protect limited groundwater supplies and surface waters for future use. If the water remains in the original source and is not used for other purposes, municipal conservation could help maintain existing water quality of these resources. High use of some water sources can possibly degrade water quality over time.

Impacts on Agriculture and Natural Resources

Impacts to agricultural and natural resources should be neutral to positive. Conserved water by cities could provide additional supplies for agricultural and rural areas.

Other Relevant Factors

There are no known impacts to other water resources and management strategies.

Agricultural Conservation

The agricultural water needs in Region B include livestock and irrigated agriculture. New water supply strategies to meet these needs are limited. Water conservation for livestock is not addressed due to the diffuse nature of providing water supply. Livestock producers implement conservation strategies as an essential practice in maintaining the viability of their operations.

Table 5-5 GPCD Goals and Water Savings by Decade for Municipal Conservation

Provider	Baseline GPCD	*2020*	*2030*	*2040*	*2050*	*2060*	*2070*	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
		GPCD Goal						**Savings (ac-ft/yr)**					
Archer City	145	*134*	*129*	*123*	*120*	*120*	*120*	3	6	9	12	12	12
Archer County MUD 1	173	*161*	*155*	*150*	*146*	*146*	*146*	2	4	5	7	7	7
Holliday	138	*127*	*121*	*117*	*114*	*114*	*114*	3	7	10	14	13	13
Lakeside City	128	*118*	*113*	*108*	*106*	*105*	*104*	1	2	4	5	6	6
Scotland	325	*310*	*302*	*295*	*290*	*290*	*290*	2	6	9	12	12	12
Windthorst WSC	275	*263*	*255*	*249*	*244*	*244*	*244*	5	12	17	22	22	22
Archer – County Other	168	*154*	*151*	*148*	*146*	*144*	*144*	1	2	4	4	5	5
Baylor County SUD	206	*195*	*189*	*184*	*182*	*180*	*178*	2	5	7	9	11	14
Clay - County Other	119	*108*	*103*	*99*	*96*	*96*	*96*	7	12	16	22	21	21
Red River Authority of Texas	229	*219*	*196*	*193*	*193*	*192*	*192*	0	92	95	98	102	105
Crowell	135	*124*	*117*	*115*	*114*	*113*	*111*	1	3	3	4	5	6
Quanah	140	*127*	*121*	*116*	*116*	*116*	*116*	8	12	20	20	20	20
Bowie	162	*147*	*140*	*137*	*135*	*135*	*135*	35	55	55	57	56	56
Montague - County Other	117	*107*	*102*	*98*	*96*	*94*	*94*	11	25	37	44	63	63
Nocona Hills WSC	184	*173*	*167*	*163*	*161*	*159*	*156*	1	2	3	3	5	6
Electra	303	*290*	*283*	*276*	*273*	*270*	*270*	9	17	29	38	47	48
Harrold WSC	263	*290*	*288*	*276*	*273*	*270*	*270*	1	2	3	4	6	6
Iowa Park	131	*120*	*114*	*110*	*107*	*106*	*106*	11	25	30	41	47	47
Sheppard Air Force Base	153	*142*	*137*	*132*	*129*	*128*	*128*	11	17	29	39	44	44
Wichita Falls	153	*142*	*137*	*132*	*129*	*128*	*128*	169	340	512	686	871	884
Vernon	153	*143*	*138*	*133*	*131*	*129*	*127*	0	0	24	49	76	102
Vernon (Pipe Replacement)	-	-	-	-	-	-	-	0	313	313	313	313	313
Young - County Other	119	*107*	*102*	*98*	*96*	*96*	*96*	0	1	2	4	4	4
Olney	157	*115*	*104*	*104*	*104*	*104*	*104*	122	152	142	140	141	145
Total								**405**	**1,112**	**1,378**	**1,647**	**1,909**	**1,961**

Table 5-6 Annual Cost for Advanced Municipal Conservation by Decade ($/yr)

Provider	Capital Cost	2020	2030	2040	2050	2060	2070
Archer City		$1,315	$2,550	$3,720	$4,880	$4,880	$4,880
Archer County MUD 1		$735	$1,440	$2,145	$2,820	$2,820	$2,820
Holliday		$1,013	$2,678	$4,148	$5,529	$5,129	$5,129
Lakeside City		$460	$838	$1,413	$1,883	$2,353	$2,353
Scotland		$928	$2,351	$3,740	$4,904	$4,904	$4,904
Windthorst WSC		$1,908	$4,733	$6,661	$8,878	$8,878	$8,878
Archer - County Other		$483	$879	$1,423	$1,784	$2,010	$2,075
Baylor County SUD		$860	$1,930	$2,815	$3,539	$4,442	$5,439
Clay - County Other		$2,711	$4,877	$6,555	$8,914	$8,514	$8,514
Red River Authority of Texas[1]	$1.43 M		$101,000	$101,000	$13,000	$13,000	$13,000
Crowell		$419	$1,039	$1,131	$1,577	$2,023	$2,514
Quanah		$3,168	$4,761	$8,179	$8,121	$7,814	$7,870
Bowie		$14,142	$22,197	$21,964	$22,933	$22,359	$22,474
Montague - County Other		$4,349	$10,066	$14,947	$17,443	$25,306	$25,306
Nocona Hills WSC		$453	$797	$1,136	$1,321	$1,809	$2,240
Electra		$3,551	$6,647	$11,608	$15,137	$18,898	$19,175
Harrold WSC		$451	$859	$1,287	$1,798	$2,305	$2,398
Iowa Park		$4,545	$9,943	$12,084	$16,295	$18,762	$18,928
Sheppard Air Force Base		$4,256	$6,695	$11,534	$15,717	$17,645	$17,645
Wichita Falls		$67,492	$135,896	$204,660	$274,544	$348,440	$353,540
Vernon[2]	$8.82 M	$0	$0	$9,681	$19,776	$30,246	$40,986
Young - County Other		$148	$474	$982	$1,409	$1,512	$1,701
Olney		$48,755	$60,806	$56,938	$56,084	$56,524	$57,903
Total	**$10.25 M**	**$162,142**	**$383,456**	**$489,751**	**$508,286**	**$610,573**	**$630,672**

[1]The capital cost for Red River Authority includes an Automated Meter Infrastructure Project (AMI) to replace nearly 4,000 water meters.

[2]The capital cost for Vernon includes capital costs for water pipeline replacement to reduce losses. It is assumed that the water conservation strategies for the other municipal water users are not capitalized. It is assumed that the pipeline replacement project would occur between 2030 and 2040.

For irrigated agriculture, the primary strategies identified to address irrigation shortages are demand reduction strategies (conservation). The agricultural water conservation strategies considered include

- Changes in irrigation equipment
- Crop type changes and crop variety changes
- Conversion from irrigated to dry land farming
- Water loss reduction in irrigation canals

Water loss reduction in irrigation canals was addressed in a special study completed in 2009 as a first phase of the 2011 regional water planning effort. The *Wichita County Water*

Improvement District No. 2 Water Conservation Implementation Plan presented the study results. As a major water provider, the details of this effort are addressed in Section 5.4.2. In general, the study indicated that nine of the canal segments with the greatest water loss could be replaced with pipe for a total cost of $9,713,000 (September 2018 cost basis) saving 12,850 acre-feet/year for the full planning period (2020-2070). The canals are expected to be converted gradually over the full planning period, considering those segments that have already been converted to pipeline.

In addition to these practices, the region encourages research into development of drought-tolerant crops and implementation of a region-wide evapotranspiration and soil moisture monitoring network to aid farmers in irrigation scheduling.

Irrigation conservation is a strategy that proactively causes a decrease in future water needs by increasing the efficiency of current irrigation practices throughout the region. The adoption of irrigation conservation will help preserve the existing water resources for continued agricultural use and provides for other demands. However, without technical and financial assistance it is unlikely that aggressive irrigation conservation programs will be implemented. Also, increased efficiencies may lead to increased water application rates or increased acreage to increase crop yields while utilizing the same volume of water, thereby negating the potential for water savings.

Region B recognizes that it has no authority to implement, enforce, or regulate irrigation conservation practices. These water conservation practices are intended to be guidelines. Water conservation strategies determined and implemented by the individual water user group supersede the recommendations in this plan and are considered to meet regulatory requirements for consistency with this plan. For purposes of this plan, it is estimated that irrigators will implement such measures that result in a minimum water savings of five percent of the projected water use for counties with identified irrigation shortages. These savings, along with the estimated water savings developed for the WCWID No. 2, are shown in Table 5-7. The conservation quantities shown in Table 5-7 can be achieved by advances in plant breeding, which are estimated to cost $9.50 per acre-foot per year.

Table 5-7 Water Savings by Decade for Irrigation Conservation

WCWID No. 2 Water Savings from Converting Canals to Pipelines (ac-ft/yr)						
County	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Wichita	830	2,292	3,656	7,988	10,026	12,850
Voluntary On-farm Conservation Estimated at 5% of Demand (ac-ft/yr)						
County	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Archer	0	6	13	19	25	31
Wichita	0	196	392	587	783	979
Total	**830**	**2,494**	**4,061**	**8,594**	**10,834**	**13,860**

Mining Conservation

Most of the mining water use in Region B is used in gas production, and the decline in projected future use is associated with the current Barnett Shale activities declining. In accordance with §27.0511 of the Texas Water Code, Region B encourages the use of alternatives to fresh water for oil and gas production whenever it is economically and technically feasible to do so. Furthermore, Region B recognizes the regulatory authority of the Railroad Commission and the TCEQ to determine alternatives to freshwater use in the permitting process.

Oil and gas companies have been actively pursuing recycling and reuse of the make-up water. These activities are a form of conservation, which is a demand management strategy that decreases future water needs by treating and reusing water used in mining operations. Mining conservation and recycling are possible for both oil and gas mining as well as sand and gravel mining. Mining recycling and conservation were considered for all mining operations in Region B.

The amount of water that can be reused/recycled is dependent on the amount of water that flows back to the surface during and after the completion of the hydraulic fracturing or oil field flooding. For planning purposes, it is assumed that 25 percent of projected water demands for mining purposes would be sourced from waters that are not suitable for other demands (such as brackish water) or would be available through flow back and reuse/recycle. In other words, the anticipated amount of water conservation is equal to 25 percent of the projected demand. The flow back water is of low quality and requires treatment or must be blended with fresh water. Some of the flow back water will be lost during the treatment process.

Mining water conservation could result in savings of 1,301 acre-feet in 2020, decreasing as the drilling activity decline to savings of 426 acre-feet per year in 2070. The mining water savings by county is provided in Table 5-8.

Table 5-8 Mining Water Conservation by Decade (ac-ft/yr)

County	2020	2030	2040	2050	2060	2070
Archer	101	121	86	70	53	53
Baylor	4	4	3	3	3	3
Clay	153	197	146	118	89	89
Cottle	10	10	10	9	8	8
Foard	3	3	3	3	3	3
Hardeman	4	4	5	5	5	5
King	95	83	72	63	55	55
Montague	910	644	402	173	194	194
Wichita	16	15	14	12	11	11
Wilbarger	5	5	5	5	5	5
Young	0	0	0	0	0	0
Total	**1,301**	**1,086**	**746**	**461**	**426**	**426**

Costs for mining conservation may vary considerably depending upon the proximity to water sources, treatment options available, and other factors. Capital costs are equal to $9,400 times the maximum annual conservation amount, in ac-ft/yr. Annual costs are assumed to be $2,800 per ac-ft/yr of water conserved. The costs shown in Table 5-9 are based on treating flow back water using different treatment technologies.

Table 5-9 Mining Conservation Costs in Region B by County

County	Capital Cost	Annual Costs					
		2020	2030	2040	2050	2060	2070
Archer	$1,137,000	$283,000	$339,000	$241,000	$196,000	$148,000	$148,000
Baylor	$38,000	$11,000	$11,000	$8,000	$8,000	$8,000	$8,000
Clay	$1,852,000	$428,000	$552,000	$409,000	$330,000	$249,000	$249,000
Cottle	$94,000	$28,000	$28,000	$28,000	$25,000	$22,000	$22,000
Foard	$28,000	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000
Hardeman	$47,000	$11,000	$11,000	$14,000	$14,000	$14,000	$14,000
King	$893,000	$266,000	$232,000	$202,000	$176,000	$154,000	$154,000
Montague	$8,554,000	$2,548,000	$1,803,000	$1,126,000	$484,000	$543,000	$543,000
Wichita	$150,000	$45,000	$42,000	$39,000	$34,000	$31,000	$31,000
Wilbarger	$47,000	$14,000	$14,000	$14,000	$14,000	$14,000	$14,000
Young	$0	$0	$0	$0	$0	$0	$0
Total	**$12,840,000**	**$3,642,000**	**$3,040,000**	**$2,089,000**	**$1,289,000**	**$1,191,000**	**$1,191,000**

Steam Electric Power Conservation

Wichita and Wilbarger counties are the only counties in Region B with Steam Electric Power needs. The needs in Wichita County can be met with contractual supplies from Wichita Falls. The needs in Wilbarger County however are associated with a decline in the supplies from Lake Kemp. Options for additional sources of supply in Wilbarger County are limited. Previous investigations into local brackish groundwater found that the quantity was limited, and the TDS levels were very high. The most likely option would be to retrofit the facility for alternative cooling technology. Transitioning to this kind of technology is a form of conservation, which is a demand management strategy that decreases future water needs by using alternative sources, such as air for cooling. The Oklaunion plant, in Wilbarger County, is closing in 2020. Future demands for Steam Electric Power in Wilbarger County are uncertain. Table 5-10 shows the projected savings from Steam Electric Power Conservation. Capital costs are estimated at $101.5 million in September 2018 dollars.

Table 5-10 Steam Electric Power Conservation Water Savings by Decade (ac-ft/yr)

County	2020	2030	2040	2050	2060	2070
Wichita	3	4	5	6	7	10
Wilbarger	0	2,302	2,903	3,504	4,105	4,706
Total	**3**	**2,306**	**2,908**	**3,510**	**4,112**	**4,716**

5.3.4 Water Conservation Summary

Water conservation is a demand management strategy than can reduce projected demands and extend the availability of existing supplies. Water conservation strategies have been specifically identified for municipal, irrigation and mining demands. It is expected that conservation strategies will also be adopted by manufacturing and livestock demands, but these have not been quantified. Table 5-11 provides a summary of the conservation savings by decade.

Table 5-11 Summary of Conservation Savings by Water Use (ac-ft/yr)

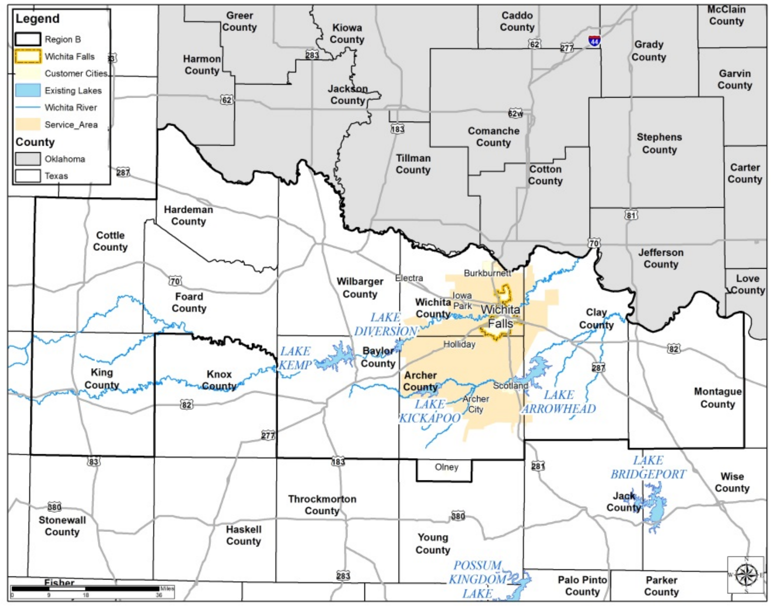
Use	2020	2030	2040	2050	2060	2070
Municipal	405	1,112	1,378	1,647	1,909	1,961
Irrigation	830	2,494	4,061	8,594	10,834	13,860
Mining	1,301	1,086	746	461	426	426
SEP	3	2,306	2,908	3,510	4,112	4,716
Total	**2,539**	**6,998**	**9,093**	**14,212**	**17,281**	**20,963**

5.4 Major Water Providers

There are two major water providers in Region B. Both major providers are projected to have needs within the planning period. Discussion of the water needs and recommended water management strategies for each of the major water providers is as follows.

5.4.1 Wichita Falls

The City of Wichita Falls is located in the southeastern portion of Wichita County and has a current population of 104,576. It is the largest city in a radius of about 100 miles, and the nearby communities and towns share economic and cultural ties to Wichita Falls.



The service area of Wichita Falls is approximately 70 percent of the entire Region B population and the municipal water demand on the Wichita Falls system accounts for approximately 82 percent of the total Region B municipal demand. With the majority of the municipal demand being dependent on the City of Wichita Falls for the next 50 years, it is imperative that management strategies be identified and evaluated to increase the system reliability.

In 2014, the City initiated a Long-Range Water Supply Plan[1] in response to on-going extreme drought conditions. As part of this plan, the City conducted an initial screening of 23 potential measures including several interim short-term measures. Eleven measures were selected for further evaluation and detailed evaluation of these strategies led to a scenario selection with the following five recommended measures:

<u>Recommended Strategies:</u>

- Water Conservation
- Indirect Reuse
- Local Seymour Aquifer (Short-Term)
- Wichita River Supply (Short-Term)
- Lake Ringgold

Since that time, the City has implemented their indirect reuse project at Lake Arrowhead. The remaining measures in the recommended strategy scenario from the Long-Range Water Supply Plan were reviewed in the context of regional water planning. The costs have been adjusted to be consistent with regional planning requirements. The City is also supportive of Brush Control which is discussed for Wichita County in in Section 5.5.9.

Water Conservation/Efficiency

Water Conservation/Efficiency has been a critical drought response strategy for the City of Wichita Falls. Through conservation and drought management, the City was able to reduce its demand by 50 percent during the recent drought. While these measures were critical for demand management during the drought, now that the drought has ended, some water efficiency measures should be continued, some measures may be discontinued, and additional measures could be implemented. The measures considered in this strategy include:

Water Quantity, Reliability and Cost

For the purposes of this plan it was assumed that Wichita Falls could reduce demand by up to 884 acre-feet per year by 2070 by actively implementing the best management practices identified in Section 5.3.3.

The City has an active leak detection, repair and pipeline replacement program and it is expected that the City will continue with this program. The amount of additional water savings can vary depending on how proactive the program is at identifying leaks and replacing pipe.

The reliability is moderate because this strategy relies on actions of others (customers) and the willingness to change daily behaviors. The suite of recommended strategies focuses on the actions of Wichita Falls, which have shown to be successful in reducing water consumption for other entities.

As shown in Table 5-6 the estimated annual cost for water conservation ranges from $67,492 ($1.23 per 1,000 gallons) in 2020 up to $353,540 by 2070 (These costs are actually less if cost savings for deferred pumping and treatment are considered).

Environmental Factors

Potential water quality impacts associated with water conservation should be neutral to positive. Reductions in water use should increase the water remaining in the lakes and streams, potentially improving the water quality.

Impacts on Water Resources and other Water Management Strategies

Potential impacts associated with water conservation should be neutral to positive. Reductions in water use may delay implementing new strategies and reduce demands on existing water resources.

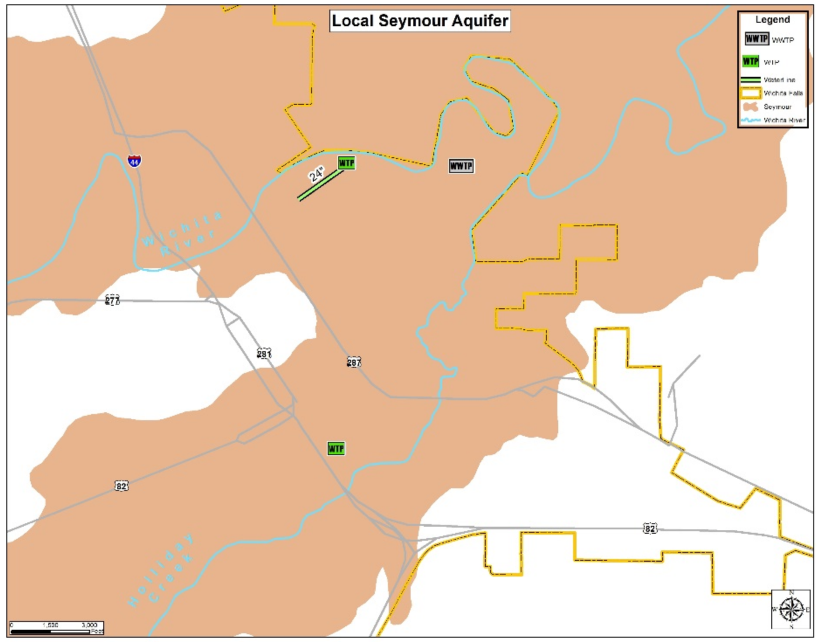
Impacts on Agriculture and Natural Resources

No impacts to agriculture and natural resources were identified.

Other Relevant Factors

There may be a tendency by customers to revert back to water use patterns prior to the drought. It is the goal of this alternative to create a new normal with the same quality of life (reasonable restrictions) while reducing consumption.

Local Seymour Aquifer



This strategy includes the construction and development of groundwater supply wells in the Seymour Aquifer along the Wichita River, on lands owned by private landowners, city-owned properties and others. Based on a preliminary study performed by INTERA Geoscience & Engineering, it is anticipated that twenty-five (25) wells pumping at approximately 35 GPM (0.05 MGD) could potentially provide Wichita Falls with a supplemental potable finished water supply of about 1MGD (500 acre-feet per year) for a limited period. The reliable supply under long-term pumping is unknown. To develop the 1 MGD, the wells would be spaced approximately 1,000 feet apart with collection lines from the well system being pumped into a ground storage tank. The water would need to be treated by Reverse Osmosis (RO) because the water quality does not meet drinking water standards. For this strategy, it is assumed treatment would occur on site, and then the water would be pumped directly into the water distribution system. The brine waste stream from the RO plant would be discharged to the Wichita River.

Water Quantity, Reliability and Cost

The Seymour Aquifer is an unconfined aquifer, which means that the water supply is contingent upon direct recharge. During drought conditions, water levels and supplies will likely decline. Also, the nature of the formation and the location of this strategy along the Wichita River suggest that the aquifer has hydrologic connections to the river. During drought, the aquifer likely discharges to the river. Extended pumping on this formation during drought is expected to have a low reliability. The amount of water available under the MAGs for strategies in Wichita County is approximately 1,000 acre-feet per year. It is assumed that this strategy would provide 500 acre-feet of finished water. This means that 667 acre-feet per year would be pumped from the aquifer and 25 percent would be discharged with the brine waste from water treatment.

As previously discussed, the long-term reliability of this water is unknown. If selected, this project should be phased in with continuous onsite evaluations being conducted as additional wells are developed.

To provide 1 MGD (500 acre-feet per year) of finished water it is estimated the total capital cost would be $14.8 million with an annual cost of $14.34 per thousand gallons with debt service and an average annual cost of $7.93 per thousand gallons after debt service.

Environmental Factors

There should be minimal environmental impacts with the construction of the wells, small amount of line work and construction of the treatment plant and pump station. There will also be potential water quality impacts to the Wichita River with the discharge of the reject water from the RO treatment plant. However, if the total discharges to the Wichita River do not exceed the permitted discharges from the Cypress WTP, the impacts should be neutral.

Based on water quality analysis from existing wells on this property, the water will meet all drinking water standards with the exception of Total Dissolved Solids (TDS), chlorides, sulfates, and iron. However, it is anticipated that by constructing a small onsite RO treatment plant, this water could be pumped directly into the City's distribution system.

Impacts on Water Resource and Other Water Management Strategies

This strategy may reduce water supplies that are currently being sold for other uses, such as mining and landscape irrigation.

Impacts on Agriculture and Natural Resources

The impact on agriculture and naturals resources should be minimal.

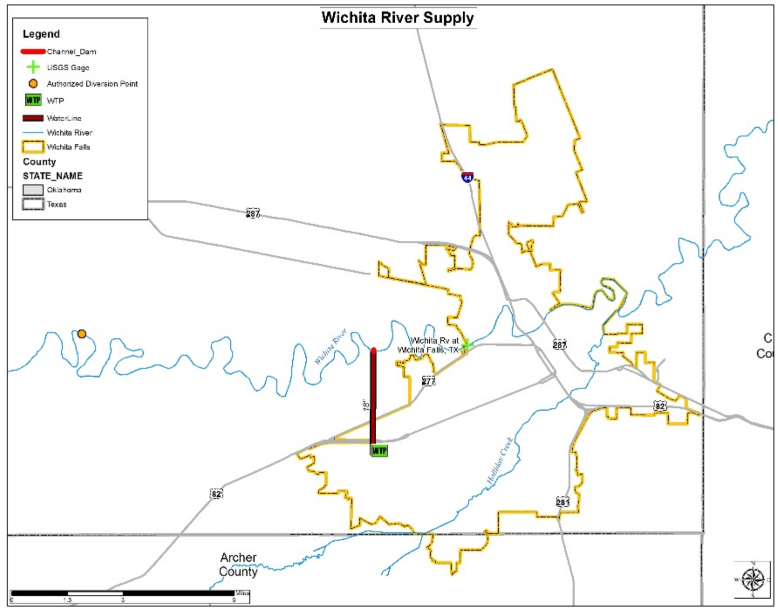
Other Relevant Factors

The City would need to negotiate an agreement with existing landowners for the water rights and then would need to pursue a RO discharge permit with TCEQ (either as a new permit or amendment to the Cypress WTP permit). Also, with additional wells currently being drilled at this site, the City should acquire the pumping and well performance data for further monitoring and site evaluation.

Summary

Considering the small amount of supply, the uncertainty of its reliability, and high unit costs, this strategy is not recommended for Wichita Falls.

Wichita River Supply



The Wichita River Supply is another short-term strategy considered for Wichita Falls in the 2015 Long-Range Water Supply Plan. This strategy proposes a direct diversion from the Wichita River at the City of Wichita Falls, and the water is transported to the City's water treatment plant. The water right for Lake Kemp authorizes diversion and use of up to 16,600 acre-feet per year for irrigation purposes from the Wichita River. This water right has not been used to date and there is no infrastructure to use this supply for irrigation purposes. For this strategy, it is assumed that the Lake Kemp water right would be amended to allow for municipal use from a new diversion point located further downstream from the point currently authorized. The strategy assumes that a small diversion structure is constructed just upstream of the Cypress WTP discharge location. Water would be pumped directly from the river and treated at the Cypress WTP or blended with existing supplies for conventional treatment.

Water Quantity, Reliability and Cost

There is very little unappropriated water in the Wichita River Basin. The existing water right associated with Lake Kemp has a 10 and 13.3 cfs instream flow by-pass requirement. Considering the limitations associated with moving the diversion point downstream and the by-pass requirement, there is little reliable supply from the Wichita River. This strategy was designed for 2 MGD for the Long-Range Water Supply Plan to provide water when there was flow in the river. However, during the recent drought, the amount of available water would be 400 acre-feet per year.

Based on an analysis of the historical flows at the Wichita Falls gage, it appears that the base flow in the river may be dependent on overflows and return flows from the upstream irrigation district. Curtailment of irrigation use or implementation of irrigation conservation and efficiency strategies may reduce the reliable flows in the river. Also, flows at the Wichita Falls gage after 2009 include discharge flows from the Cypress WTP.

The cost estimate assumes that the City will construct a channel dam just upstream of the current Cypress WTP outfall. An intake pump station would be constructed along with an 18" water line to the Cypress WTP for blending. The total capital cost is estimated at $20.6 million. The unit cost with debt service is $22.94 per thousand gallons and $13.06 per thousand gallons after debt service. This cost assumes a 4 MGD pump station at the river. The City could reliably divert more than 4 MGD during normal rainfall periods, but a larger intake pump station would be needed. It is estimated that implementation of this strategy could take three to five years.

Environmental Factors

To access the Wichita River supply the City would need to build a channel dam to create a pool for diversion. At the channel dam they would need to construct an intake structure. Both of these items along with reduced stream flows due to diversions could impact waters of the U.S. and may require mitigation. Construction of a channel dam would require a Section 404 permit.

Impacts on Water Resources and Other Water Management Strategies

Wichita Falls would need to amend the existing Certificate of Adjudication 02-5123 to move the diversion location downstream on the Wichita River and amend the use type to include municipal use. There is currently an instream flow requirement that the flows may be diverted only when the remaining flow of the river equals or exceeds 10 cfs and 13 cfs at the diversion points.

Impacts on Agriculture and Natural Resources

This diversion has not been historically used by any water right user although this right is jointly held by the Wichita County Water Improvement District No. 2 (WCWID No. 2) and Wichita Falls. An agreement would need to be reached with WCWID No. 2 to allow for change of diversion and use. This does potentially preclude WCWID No. 2 from using this supply in the future. This strategy does not have an impact on current agricultural water use since this water supply has never been used.

Other Relevant Factors

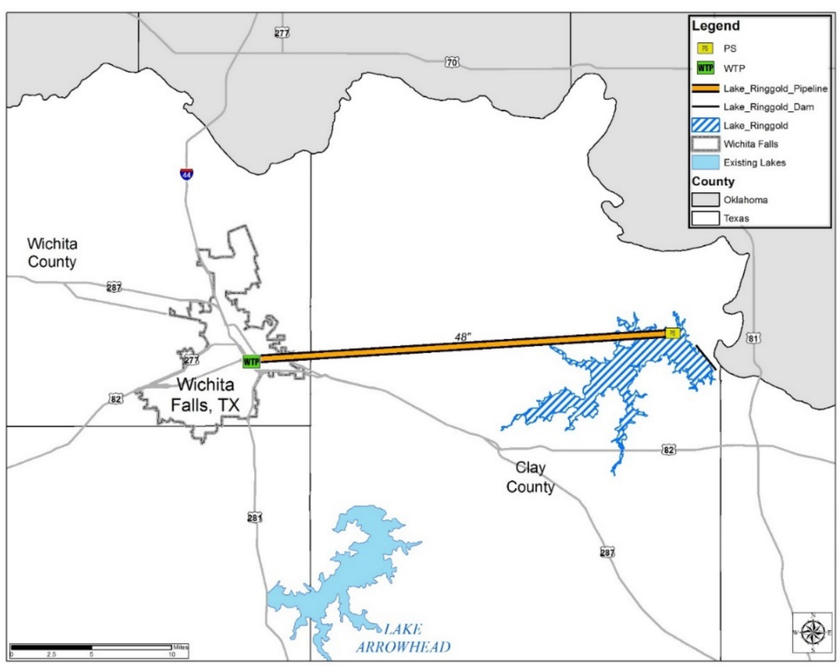
The relevant factors include the potential water quality, treatment options, storage options, and the potential impact of irrigation operations on reliable supply. Also since this supply is not fully reliable it would need to be combined with other sources.

Summary

This strategy is not a recommended strategy for Wichita Falls. The uncertainty of the supply, water quality, and high unit costs make this strategy less desirable than other potentially feasible strategies.

Lake Ringgold

Lake Ringgold is a proposed 16,000-acre reservoir site located in Clay County, Texas. The proposed dam would be located on the Little Wichita River, approximately 0.5 miles upstream of its confluence with the Red River, and would impound 275,000 acre-feet of water at the normal pool elevation of 844 feet-msl.



This strategy includes construction of the Lake Ringgold dam, intake pump station and a 30-mile pipeline to transport water to the City. Alternatively, the City may transport water to Lake Arrowhead for subsequent transmission to Wichita Falls. The recommend strategy supply is based on the firm yield of the reservoir based on an Excel model with extended hydrology through June 2015.

This reservoir site has been considered as a potential water supply source for Wichita Falls since 1958. There have been many studies on the feasibility of this project, with the most recent study completed in 2012. Information from the 2012 Feasibility Study[2] and information from the Report Supporting the Texas Water Right for Lake Ringgold[3] were used as the basis for this evaluation.

Water Quantity, Reliability and Cost

The firm yield for Lake Ringgold using the Red River WAM is 28,090 acre-feet per year. With the Excel model and the extended hydrology through June 2015, the firm yield of Lake Ringgold is 23,450 acre-feet per year. The reliability of this water supply would be good, but with the reservoir site being downstream and in the same drainage basin as the two existing lakes, Lake Ringgold would likely have the same drought of record as Wichita Falls' existing Little Wichita River lakes.

Of the 24,000 acres of land needed for the reservoir site, the City currently owns approximately 6,662 acres. Along with purchasing the remaining lands for the site, additional facilities including a 43 MGD lake intake structure and pump station facilities, and 30 miles of 48" transmission line to convey raw water to existing treatment facilities in Wichita Falls. As shown in the detailed cost estimate provided for the construction of the Lake Ringgold Reservoir, the total capital cost is $443 million with an annual cost of $4.47 per thousand gallons during debt service and $1.18 per thousand gallons after debt service. It is estimated that it will take approximately 20 years from the start of permitting until Lake Ringgold is complete. The majority of this time, 10-12 years, is estimated for the water right and Section 404 permitting process.

Environmental Factors

The construction of Lake Ringgold would require the City to obtain a water right permit from the State to impound and divert water from the Little Wichita River. It also would require a Section 404 permit from the Corps of Engineers to construct the dam.

This reservoir would be in the same drainage basin as Lake Arrowhead and Lake Kickapoo so it is anticipated that the water quality would be very similar to the existing reservoirs. There are currently three permitted wastewater discharges within or upstream of the proposed reservoir. These dischargers may be impacted by higher stream standards, requiring a higher level of treatment and nutrient removal. This impact will need to be considered in the planning and permitting effort for the reservoir. If this becomes a concern, there is sufficient time to address modification of existing wastewater plants to achieve the future stream standards and protect Lake Ringgold as a water supply reservoir.

The Lake Ringgold dam is located one-half mile upstream of the confluence of the Red River. Approximately 1,500 feet of the Little Wichita River downstream of the dam would be impacted as part of the project and the remaining stream length is under the influence of the Red River. Consistent with the yield modeling submitted to TCEQ and the special conditions of the Draft Water Rights Permit, no instream flows are included for the Lake Ringgold project.

Lake Ringgold will impact approximately 120 acres of existing ponds and stock tanks and approximately 165 miles of streams. At the conservation elevation of 844 feet, approximately 910 acres of wetlands will be impacted. An assessment of threatened and endangered species in the feasibility study found low to no potential to negatively impact any federally listed threatened or endangered species. Only two of the nine state listed species (Texas horned lizard and Texas kangaroo rat) were identified as having a moderate potential to be impacted by Lake Ringgold. The greatest uncertainty associated with Lake Ringgold is cultural resources with the project site located in an area with known American Indian activities. Approximately two-thirds of the reservoir's site was identified as high potential for cultural resources. In addition, pump stations and the pipeline into the City would be located to avoid or minimize environmental and cultural impacts.

Impacts on Water Resources and Other Water Management Strategies

Lake Ringgold is near the confluence of the Little Wichita River and the Red River Basin. The impoundment should have minimal impact on other water resources or other water management strategies. Also, the City of Henrietta's intake structure and small lake would be impacted by Lake Ringgold. A portion of the supply would need to be provided to Henrietta, but the yield in this analysis assumes that supplies to existing water right holders are met.

Impacts on agriculture and Natural resources

The Lake Ringgold alternative would have a moderate to high impact on both agriculture and rural lands in that approximately 9,700 acres of cultivated crops and grassland could be required for the site. Additional lands would likely need to be acquired for mitigation of the project. Potential mitigation sites have not been identified. For planning purpose, it is assumed that an additional 17,280 acres may be needed. The actual amount may be less.

Other Relevant Factors

Existing residences and businesses within the footprint of the reservoir would need to be acquired. Existing landowners would be compensated as part of the project. An additional challenge may be finding suitable mitigation along the Little Wichita River or near the project site.

Summary of Recommended Strategies for Wichita Falls

The City of Wichita Falls has developed strategies to meet both short-term needs and a long term strategy to meet long term growth related demands. The recommended strategies shown in Table 5-12 could provide 169 acre-feet by the year 2020, 340 by 2030, with an additional 23,450 acre-feet of supply in 2040 when Lake Ringgold is completed. Table

5-13 shows the capital and annual cost associated with the recommended water management strategies.

Table 5-12 Recommended Water Management Strategies for Wichita Falls

-Values in Acre-Feet per Year-

	2020	2030	2040	2050	2060	2070
Wichita Falls Safe Supply Need	2,250	3,574	4,242	4,873	5,646	7,868
Wichita Falls Wholesale Customer Safe Supply Need	263	601	892	1,264	1,697	2,995
Total Safe Supply Need	**2,513**	**4,175**	**5,134**	**6,137**	**7,344**	**10,864**
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	169	340	512	686	871	884
Lake Ringgold	0	0	23,450	23,450	23,450	23,450
Total	**169**	**340**	**23,962**	**24,136**	**24,321**	**24,334**
Management Supply Factor	0.1	0.1	4.7	3.9	3.3	2.2

Table 5-13 Cost of Recommended Water Management Strategies for Wichita Falls

Recommended Strategies	Capital Cost	Annual Cost					
		2020	2030	2040	2050	2060	2070
Water Conservation	$0	$67,492	$135,896	$204,660	$274,544	$348,440	$353,540
Lake Ringgold	$442,867,000			$34,139,000	$34,139,000	$20,964,000	$20,964,000
Total	**$442,867,000**	**$67,492**	**$135,896**	**$34,343,660**	**$34,413,544**	**$21,312,440**	**$21,317,540**

Additional alternative strategies were evaluated in the Long-Range Water Supply Plan and the detailed discussion is not included in this plan. The following strategies were identified as potential alternative strategies for Wichita Falls:

Alternative Strategies:

- Lake Bridgeport
- Conjunctive Use (Local Seymour and Wichita River)
- Seymour Aquifer – Wilbarger County
- Lake Texoma

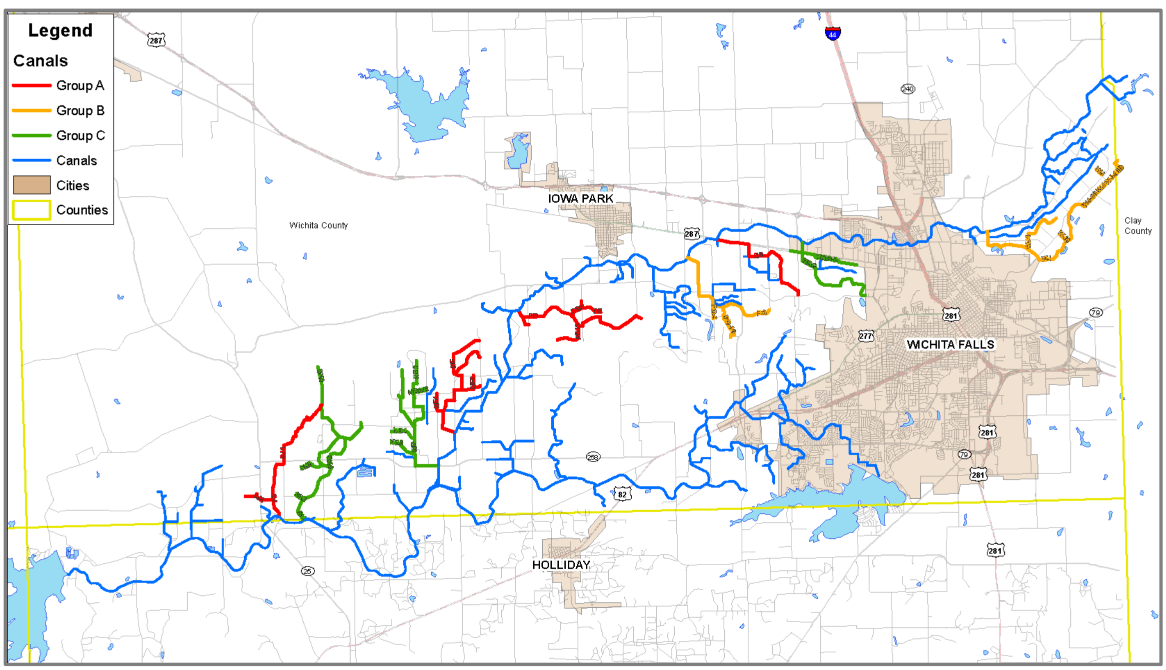
- Ogallala Aquifer - Donley County

These strategies are not recommended as alternative strategies for regional planning purposes.

5.4.2 Wichita County Water Improvement District No. 2

The Wichita County Water Improvement District No. 2 operates a canal system that distributes water to farmers from Diversion Lake located in Wichita County, Archer County, and Clay County.

A study was completed in 2009 as part of the first phase of the 2011 regional water planning effort. The study, *Wichita County Water Improvement District No. 2 Water Conservation Implementation Plan,* presents the results of an evaluation of the canals in the District. The flow and losses in some canals were measured directly. The direct measurements provided water loss per canal segment or length of canal that could then be related to other canals based on canal characteristics: soil type, canal width, and size and type of canal vegetation. The water loss evaluation indicated that nine canal segments, divided into three priority groups, should be considered for conversion to pipelines.



The costs for conversion of the canals to pipe have been updated to a September 2018 cost basis and the costs along with the water savings are presented in Table 5-14.

Table 5-14 Cost and Water Savings for Conversion of Canals to Pipelines

Lateral	Ranking	Water Saved (ac-ft/yr)	Capital Cost ($)	Annual Cost ($)	Unit Cost ($/ac-ft)
Priority Group A					
PB	1	830	$470,000	$34,900	$42.08
SJ	2	1,462	$558,500	$41,500	$28.39
RR	3	1,364	$608,800	$45,200	$33.17
NF	4	3,362	$1,925,500	$143,100	$42.57
Subtotal		***7,018***	***$3,562,800***	***$264,700***	***$37.73***
Priority Group B					
WJ	5	970	$855,200	$63,600	$65.54
PO	6	1,248	$1,429,800	$106,300	$88.24
Subtotal		***2,218***	***$2,285,000***	***$169,800***	***$76.57***
Priority Group C					
RRG	7	1,672	$1,263,400	$93,900	$56.16
SK	8	790	$684,100	$50,800	$64.35
NB	9	1,152	$1,917,200	$142,500	$123.68
Subtotal		***3,614***	***$3,864,700***	***$287,200***	***$79.47***
Total		**12,850**	***$9,713,000***	***$722,000***	**$56.19**

In general, the study indicated that nine of the canal segments with the greatest water loss could be replaced with pipe for a total cost of $9,713,000, saving 12,850 acre-feet/year by 2070 at a unit cost of $56.19 per acre-ft. This equates to a savings of approximately 33% of the projected irrigation demand. The water savings would be apportioned to Wichita County since the canals to be replaced are almost exclusively located in Wichita County.

Water Quantity, Reliability and Cost

The water savings associated with irrigation conservation varies.

Environmental Factors

Potential environmental impacts associated with irrigation conservation should be neutral to positive. Reductions in water use will preserve water for other uses, including potential environmental purposes.

Impacts on Water Resources and Other Water management Strategies

Impacts to natural resources should be neutral to positive. Conserved water by irrigation systems would protect limited surface water supplies for future use. If the water remains in the original source and is not used for other purposes, irrigation conservation could help maintain existing water quality of these resources. Excessive depletion of surface water sources can degrade water quality over time due to increased temperatures, leading to more rapid evaporation and concentration of salts.

Impacts on Agriculture and Natural Resources

Impacts to agricultural and natural resources should be neutral to positive. Conserved water could enable agricultural producers greater access to water for irrigation and would improve the natural resources in the vicinity of the water source.

Other Relevant Factors

There are no known impacts to other water resources and management strategies.

Table 5-15 Recommended Water Management Strategies for WCWID No. 2

-Values in Acre-Feet per Year-

	2020	2030	2040	2050	2060	2070
Water Need	25,327	27,746	30,165	32,584	35,003	37,422
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Canal Conversion to Pipeline	830	2,292	3,656	7,988	10,026	12,850
Management Supply Factor	0.0	0.1	0.1	0.2	0.3	0.3

Table 5-16 Cost of Recommended Water Management Strategies for WCWID No. 2

Recommended Strategies	Capital Cost	Annual Cost					
		2020	2030	2040	2050	2060	2070
Canal Conversion to Pipeline	$9,713,000	$722,000	$722,000	$7,000	$7,000	$7,000	$7,000

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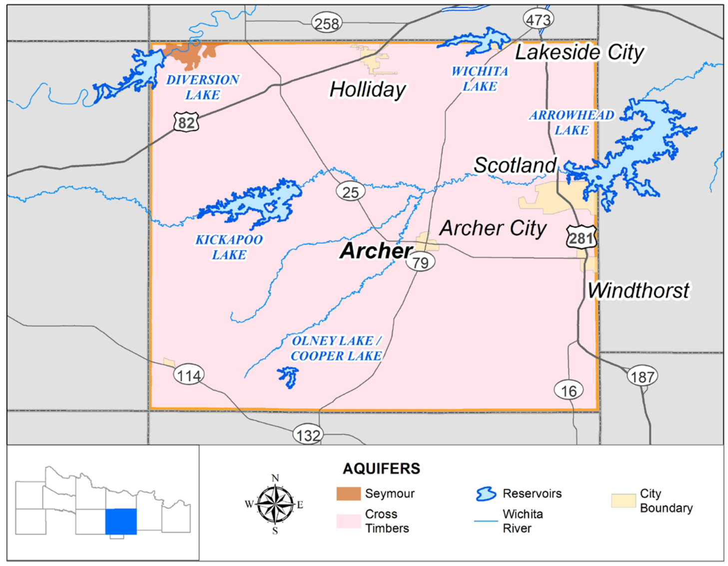
5.5 County Summaries

There are ten full counties and one partial county in Region B, of which two (Cottle and King Counties) show no projected water needs. This subchapter discusses the water issues of each county and outlines the proposed water management strategies to meet the identified needs. For some counties, there are projected shortages that cannot be met through an economically viable project. It is important to remember that economic viability of a project is based on the current understanding of the value of water and that maximum cost that can be paid for water in certain industries such as irrigated agriculture. These assumptions of economic viability may change over time and will be reevaluated in the next plan. These “unmet needs” are also identified, if present, by county. Descriptions of water management strategies that are developed by a major water provider are discussed in Section 5.4 and included in the county summary tables for completeness, as appropriate. Detailed costs are presented in Appendix C and a summary evaluation matrix is included in Appendix D.

5.5.1 Archer County



Archer County is located in the southeast portion of the Region B planning area. The population of Archer County in 2010 was 9,054, and the current population of Archer County is approximately 9,409. Most of the municipal water supply in Archer County is supplied by Wichita Falls as either treated water or raw water directly from Lakes Arrowhead or Kickapoo. Irrigation supplies are provided from Lake Kemp through a series of canals owned and operated by the WCWID No. 2. Some local groundwater supplies are used by County-Other, Livestock and Manufacturing. The total safe-supply need in Archer County is over 1,500 acre-feet by the year 2070. Individual water user groups and their strategies are listed below. For the municipal water user groups the recommended strategies include water conservation and fulfillment of the existing contracts from Wichita Falls through Wichita Falls' development of strategies. The evaluation of the recommended strategies for Wichita Falls are discussed in Section 5.4.1.

Archer City

Archer City has a raw water contract with Wichita Falls to supply 336 acre-feet per year. Archer City sells a small amount of water to Wichita Valley Water Supply Corporation (WSC). The recommended strategies for Archer City include water conservation, fulfillment of the existing contract from Wichita Falls and an increase in their contract amount.

Recommended Strategies:

- Water Conservation (Section 5.3)

- Fulfillment of Existing Contract from Wichita Falls - This strategy would provide the full contracted supply from Wichita Falls.

Summary of Recommended Strategies for Archer City

The recommended strategies for Archer City of water conservation and the existing contract from Wichita Falls are sufficient to meet the water needs, but some additional supply will be voluntarily transferred to meet the safe supply shortage. Table 5-17 shows the need and recommended strategies to meet that need. Since Archer City has an existing contract with Wichita Falls and the existing infrastructure is sufficient to deliver the full contracted amount, there are no capital or annual costs with the existing contract, however, there will be annual costs associated with voluntary water transfers of raw water at a rate of $3.50 per 1,000 gallons. Table 5-18 shows the annual cost for the recommended strategies.

Table 5-17 Archer City Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	-	-	-	-	-	20
Safe Supply Shortage	20	14	16	21	34	69
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	3	6	9	12	12	12
Fulfillment of Existing Contract with Wichita Falls	0	5	16	28	42	82
Total	3	11	25	40	54	94

Table 5-18 Archer City Capital and Annual Cost

Recommended Strategies	**Capital Cost**	**Annual Cost**					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	$0	$1,315	$2,550	$3,720	$4,880	$4,880	$4,880
Total	$0	$1,315	$2,550	$3,720	$4,880	$4,880	$4,880

<u>Archer County MUD No. 1</u>

Archer County MUD No. 1 has a treated water contract with Wichita Falls to supply an average of 84 acre-feet per year. The recommended strategies for Archer County MUD No. 1 include water conservation, fulfillment of the existing contract from Wichita Falls and voluntary transfer of additional water from Wichita Falls.

<u>Recommended Strategies:</u>

- Water Conservation (Section 5.3)
- Fulfillment of Existing Contract from Wichita Falls - This strategy would provide the full contracted supply from Wichita Falls.
- Voluntary Transfer from Wichita Falls

Summary of Recommended Strategies for Archer County MUD No. 1

The recommended strategies for Archer County MUD No. 1 of water conservation, fulfillment of the existing contract from Wichita Falls, and some additional supply through voluntary transfer are sufficient to meet the safe supply shortage needs. Table 5-19 shows the need and recommended strategies to meet that need. Since Archer County MUD has an existing contract with Wichita Falls and the existing infrastructure is sufficient to deliver the full contracted amount, there are no capital or annual costs with the existing contract, however, there will be annual costs associated with voluntary water transfers at a rate of $3.50 per 1,000 gallons. Table 5-20 shows the annual cost for the recommended strategies.

Table 5-19 Archer County MUD No. 1 Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	63	61	63	65	68	78
Safe Supply Shortage	92	90	92	93	96	106
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	2	4	5	7	7	7
Fulfillment of Existing Contract with Wichita Falls	0	1	4	7	10	21
Voluntary Transfer from Wichita Falls	61	56	83	79	79	78
Total	63	61	92	93	96	106

Table 5-20 Archer County MUD No.1 Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	2030	2040	2050	2060	2070
Water Conservation	$0	$735	$1,440	$2,145	$2,820	$2,820	$2,820
Voluntary Transfer	$0	$69,569	$2,281	$3,421	$2,281	$5,702	$17,106
Total	$0	$70,304	$3,721	$5,566	$5,101	$8,522	$19,926

<u>Archer County – Other</u>

Archer County - Other has safe water needs that begin with 65 acre-feet per year in 2020 and then decrease to 32 acre-feet per year in 2070. Recommended strategies to meet this need include:

- Water Conservation (Section 5.3)
- Voluntary Transfer from nearby entities

Summary of Recommended Strategies for Archer County-Other

The recommended strategies for Archer County Other of water conservation and voluntary transfer from nearby entities are sufficient to meet the safe supply shortage needs. It is assumed there will be no capital costs associated with voluntary transfer, however, there will be annual costs associated with the water transfers at a rate of $3.50 per 1,000 gallons. Table 5-21 shows the need and recommended strategies to meet that need and Table 5-22 shows the annual cost for the recommended strategies.

Table 5-21 Archer County -Other Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	38	19	13	12	11	11
Safe Supply Shortage	65	42	35	33	32	32
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	1	2	4	4	5	5
Voluntary Transfer	37	17	31	29	27	27
Total	38	19	35	33	32	32

Table 5-22 Archer County-Other Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	2030	2040	2050	2060	2070
Water Conservation	$0	$483	$879	$1,423	$1,784	$2,010	$2,075
Voluntary Transfer	$0	$42,198	$19,388	$35,355	$33,074	$30,793	$30,793
Total	$0	$42,681	$20,267	$36,778	$34,858	$32,803	$32,868

Holliday

Holliday has a treated water contract with Wichita Falls to supply "sufficient quantities to meet Holliday's needs". The recommended strategies for Holliday include water conservation and fulfillment of the existing contract from Wichita Falls.

Recommended Strategies:

- Water Conservation (Section 5.3.2.1)
- Fulfillment of Existing Contract from Wichita Falls - This strategy would provide for the full contracted supply from Wichita Falls.

Summary of Recommended Strategies for Holliday

The recommended strategies for Holliday of water conservation and the existing contract from Wichita Falls are sufficient to meet the safe supply shortages. Table 5-23 shows the need and recommended strategies to meet that need. Since Holliday has an existing contract with Wichita Falls and the existing infrastructure is sufficient to deliver the full contracted amount, there are no capital or annual costs associated with fulfillment of the contractual obligations. Table 5-24 shows the annual cost for the recommended strategies.

Table 5-23 Holliday Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	-	4	13	22	31	64
Safe Supply Shortage	36	55	65	74	83	116
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	3	7	10	14	13	13
Fulfillment of Existing Contract with Wichita Falls	0	4	55	60	70	103
Total	3	11	65	74	83	116

Table 5-24 Holliday Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	$0	$1,013	$2,678	$4,148	$5,529	$5,129	$5,129

Lakeside City

Lakeside City has a treated water contract with Wichita Falls to supply an average annual supply of 179 acre-feet. The recommended strategies for Lakeside City include water conservation and fulfillment of the existing contract from Wichita Falls.

Recommended Strategies:

- Water Conservation (Section 5.3.2.1)
- Fulfillment of Existing Contract from Wichita Falls - This strategy would provide for the full contracted supply from Wichita Falls.

Summary of Recommended Strategies for Lakeside City

The recommended strategies for Lakeside City of water conservation and the existing contract from Wichita Falls are sufficient to meet the safe supply shortages. Table 5-25 shows the need and recommended strategies to meet that need. Since Lakeside City has an existing contract with Wichita Falls and the existing infrastructure is sufficient to deliver the full contracted amount, there are no capital cost or annual costs associated with fulfillment of the contractual obligations. Any water purchased would be under the existing contract. Table 5-26 shows capital cost and the annual cost for the recommended strategies.

Table 5-25 Lakeside City Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	-	-	-	-	-	-
Safe Supply Shortage	-	-	-	-	-	8
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	1	2	4	5	6	6
Fulfillment of Existing Contract with Wichita Falls	0	0	0	0	0	2
Total	1	2	4	5	6	8

Table 5-26 Lakeside City Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	$0	$460	$838	$1,413	$1,883	$2,353	$2,353

Scotland

Scotland has a treated water contract with Wichita Falls to supply an average annual supply of 202 acre-feet. The recommended strategies for Scotland include water conservation and voluntary transfers from Wichita Falls.

Recommended Strategies:

- Water Conservation (Section 5.3.2.1)
- Fulfillment of Existing Contract from Wichita Falls - This strategy would provide the full contracted supply from Wichita Falls.
- Voluntary Transfer from Wichita Falls

Summary of Recommended Strategies for Scotland

The recommended strategies for Scotland of water conservation and voluntary transfers from Wichita Falls are sufficient to meet the safe supply shortages. Table 5-27 shows the need and recommended strategies to meet that need. Table 5-28 shows capital cost and the annual cost for the recommended strategies.

Table 5-27 Scotland Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	-	43	47	54	63	87
Safe Supply Shortage	31	91	95	102	111	135
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	2	6	9	12	12	12
Fulfillment of Existing Contract with Wichita Falls	0	3	10	17	25	50
Voluntary Transfer from Wichita Falls	0	34	76	73	74	73
Total	2	43	95	102	111	135

Table 5-28 Scotland Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	$0	$928	$2,351	$3,740	$4,904	$4,904	$4,904
Voluntary Transfer	$0	$0	$38,776	$86,676	$83,255	$84,395	$83,255
Total	$0	$928	$41,127	$90,416	$88,159	$89,299	$88,159

Windthorst WSC

Windthorst WSC has a raw water contract with Wichita Falls to supply an average annual supply of 420 acre-feet. The recommended strategies for Windthorst WSC in both Archer and Clay Counties include water conservation and fulfillment of the existing contract from Wichita Falls.

Recommended Strategies:

- Water Conservation (Section 5.3.2.1)
- Fulfillment of Existing Contract from Wichita Falls - This strategy would provide for the full contracted supply from Wichita Falls.
- Voluntary Transfer from Wichita Falls

Summary of Recommended Strategies for Windthorst WSC

The recommended strategies for Windthorst WSC of water conservation and voluntary transfers from Wichita Falls are sufficient to meet the safe supply shortages. Table 5-29 shows the need and recommended strategies to meet that need. Since Windthorst WSC has an existing contract with Wichita Falls and the existing infrastructure is sufficient to deliver the full contracted amount, there are no capital or annual costs associated with fulfillment of the contractual obligations. Table 5-30 shows capital cost and the annual cost for the recommended strategies.

Table 5-29 Windthorst WSC Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	13	30	42	54	71	121
Safe Supply Shortage	100	119	130	142	159	209
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	5	12	17	22	22	22
Fulfillment of Existing Contract with Wichita Falls	0	6	20	35	52	103
Voluntary Transfer from Wichita Falls	8	12	93	85	85	84
Total	13	30	130	142	159	209

Table 5-30 Windthorst WSC Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	$0	$1,908	$4,733	$6,661	$8,878	$8,878	$8,878
Voluntary Transfer	$0	$9,124	$13,686	$106,065	$96,941	$96,941	$95,800
Total	$0	$11,032	$18,419	$112,726	$105,819	$105,819	$104,678

Irrigation – Archer County

Irrigation is projected to have a shortage of 757 acre-feet per year by 2070. The recommended strategy for irrigation in Archer County is agricultural conservation, which is discussed in Section 5.4.2 as part of the conservation that could be achieved by the WCWID No. 2.

Summary of Recommended Strategies for Irrigation-Archer County

The recommended strategy for irrigation in Archer County is water conservation and CCP. Table 5-31 shows the need and recommended strategy to meet that need. The capital cost and the annual cost for the canal replacement project are shown for WCWID No. 2. Table 5-32 shows the annual cost for irrigation conservation.

Table 5-31 Irrigation – Archer County Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	470	527	585	642	699	757
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	0	6	13	19	25	31
Unmet Water Need	470	521	572	623	674	726

Table 5-32 Irrigation – Archer County Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	$0	$0	$57	$124	$181	$238	$295
Total		$0	$57	$124	$181	$238	$295

<u>Mining – Archer County</u>

Mining has a projected shortage of 255 acre-feet per year in 2020 and that shortage reduces to 67 acre-feet per year by 2070. There are few options for additional supplies for mining. The recommended water supply strategy for mining in Archer County is conservation which is expected to provide for approximately 30 percent of the projected shortage.

Summary of Recommended Strategies for Mining-Archer County

The recommended strategy for mining in Archer County is water conservation. Table 5-33 shows the need and recommended strategy to meet that need. Even with conservation, there is a projected unmet water need for mining. Costs for mining conservation are shown on Table 5-34.

Table 5-33 Mining – Archer County Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	325	401	265	201	137	137
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	101	121	86	70	53	53
Unmet Water Need (ac-ft/yr)	**224**	**282**	**179**	**131**	**84**	**84**

Table 5-34 Mining – Archer County Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	2030	2040	2050	2060	2070
Water Conservation	$1,150,000	$253,000	$303,000	$215,000	$175,000	$133,000	$133,000
Total		$253,000	$303,000	$215,000	$175,000	$133,000	$133,000

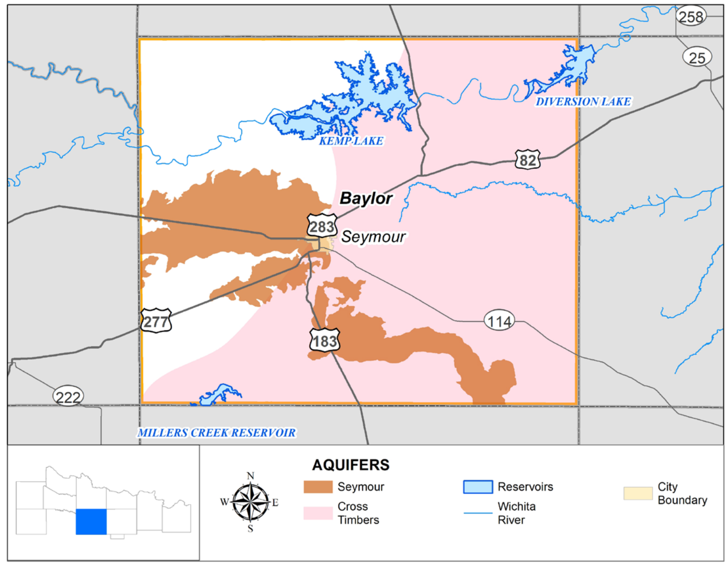
Archer County Summary

The maximum projected firm water need for Archer County is 1,237 acre-feet per year with most of this need (757 acre-feet per year) associated with an irrigation supply shortage. The remainder of the need is associated with insufficient supplies for existing contracts with Wichita Falls and mining. As Wichita Falls develops its strategies to meet its contractual demands, the municipal water needs will be met. The safe need for Archer County through the planning period is 1,503 acre-feet per year. This safe supply need will be met through Wichita Falls' supplies. Irrigation and Mining are shown to have an unmet need due to limited supplies.

Table 5-35 Archer County Recommended Strategies Summary

Water User	Strategy Description	Max Supply (ac-ft/yr)	Max Cost/ 1,000 gal	Implement Decade
Archer City	Water Conservation	12	$1.35	2020
	By Contract	82	NA	2030
Archer County MUD 1	Water Conservation	7	$1.32	2020
	By Contract	21	NA	2030
	Voluntary Transfer	83	$3.50	2020
County-Other	Water Conservation	5	$1.48	2020
	Voluntary Transfer	37	$3.50	2020
City of Holliday	Water Conservation	14	$1.27	2020
	By Contract	103	NA	2020
Lakeside City	Water Conservation	6	$1.41	2020
	By Contract	2	NA	2030
Scotland	Water Conservation	12	$1.42	2020
	By Contract	50	NA	2030
	Voluntary Transfer	76	$5.00	2020
Windthorst WSC	Water Conservation	22	$1.24	2030
	By Contract	103	NA	2030
	Voluntary Transfer	93	$3.50	2020
Irrigation	Water Conservation	31	$0.03	2020
Mining	Water Conservation	121	$7.69	2020
TOTAL		**879**		
Unmet Max Irrigation Need of 726 acre-feet per year by 2070 and Unmet Max Mining Need of 280 acre-feet per year in 2030.				

5.5.2 Baylor County



Baylor County is located in the south central portion of the Region B planning area. The population of Baylor County in 2010 was 3,726, and the county's population has remained level at approximately 3,726. Most of the water supply in Baylor County is supplied from the Seymour Aquifer, Other supplies include local aquifer, Millers Creek Reservoir, run-of-river supplies and stock ponds. The total safe supply need in Baylor County through 2070 is approximately 31 acre-feet per year. Individual water user groups and their strategies are listed below.

<u>Baylor County SUD</u>

Baylor County SUD is only showing a safe supply shortage need during the planning period. The recommended strategies for Baylor County SUD include water conservation and additional groundwater development. Table 5-36 shows the need and recommended strategies for Baylor County SUD. Table 5-37 shows the capital and annual cost of the strategies to meet the needs.

Table 5-36 Baylor County SUD Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	0	0	0	0	0	0
Safe Supply Shortage	26	26	25	28	29	31
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	2	5	7	9	11	14
Additional Groundwater Development	26	26	25	28	29	31
Total	28	31	32	37	40	45

Table 5-37 Baylor County SUD Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	2030	2040	2050	2060	2070
Water Conservation		$860	$1,930	$2,815	$3,539	$4,442	$5,439
Additional Groundwater Supply	$138,000	$11,000	$11,000	$11,000	$1,000	$1,000	$1,000
Total	$138,000	$11,860	$12,930	$13,815	$4,539	$5,442	$6,439

Baylor County Summary

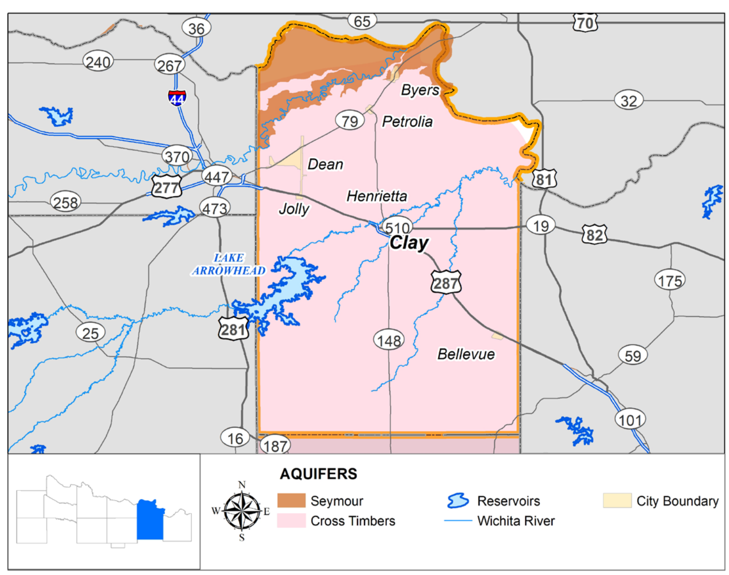
The maximum projected water need for Baylor County is 31 acre-feet per year and is associated with Baylor County Special Utility District (SUD). A summary of the recommended strategies for Baylor County is shown on Table 5-38.

Table 5-38 Baylor County Recommended Strategies Summary

Water User	Strategy Description	Max Supply (ac-ft/yr)	Max Cost/ 1,000 gal	Implement Decade
Baylor County SUD	Water Conservation	14	$1.32	2020
	New Well in Seymour Aquifer	31	$1.09	2020
TOTAL		45		

5.5.3 Clay County

Clay County is located in the eastern portion of the Region B planning area. The population of Clay County in 2010 was 10,752, and the current population is approximately 11,154. The water supply in Clay County is supplied from a variety of sources including the Seymour Aquifer, Other supplies include local aquifer, run-of-river supplies stock ponds, and contracts with Wichita Falls. The total safe-supply need in Clay County is



approximately 247 acre-feet by the year 2070. Individual water user groups and their strategies are listed below.

Clay County - Other

Clay County-Other has sufficient supplies to meet its water needs but is shown to have a small safe supply need. Municipal conservation, which is discussed in Section 5.3.2.1, will meet some of the safe supply shortage. To meet the remaining safe supply need, small rural communities could purchase water from Henrietta. Henrietta is shown to have supplies in excess of their needs.

Summary of Recommended Strategies for Clay County-Other

The recommended strategy for Clay County-Other is water conservation and voluntary transfer at $3.50 per 1,000 gallons. It is assumed that no additional infrastructure is needed. Table 5-39 shows the need and recommended strategy to meet that need. Table 5-40 shows the capital cost and the annual cost for the recommended strategies.

Table 5-39 Clay County Other Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	-	-	-	-	-	-
Safe Supply Shortage	77	82	66	58	57	57
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	7	12	16	22	21	21
Voluntary Transfer	70	70	70	70	70	70
Total	77	82	86	92	91	91

Table 5-40 Clay County-Other Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	$0	$2,711	$4,877	$6,555	$8,914	$8,514	$8,514
Voluntary Transfer	$0	$79,833	$79,833	$79,833	$79,833	$79,833	$79,833
Total	$0	$82,544	$84,710	$86,388	$88,747	$88,347	$88,347

Red River Authority

Red River Authority (RRA) purchases raw water from the City of Wichita Falls and provides for treatment and distribution to rural Clay County customers adjacent to Lake Arrowhead. By 2070, RRA expects a safe need supply shortage of 124 acre-feet per year. Furthermore, RRA is in the process of negotiating a contract for treated water and intends to abandon their existing Lake Arrowhead Water Treatment Plant and purchase up to 1 MGD of treated water from the City of Wichita Falls.

This project will require approximately 7 miles of treated water transmission line from Wichita Falls to an existing RRA pump station near Lake Arrowhead and the purchase of treated water from the City of Wichita Falls at an estimated cost of $3.50 per 1,000 gallons. While the current raw supply and future treated supply are both provided by the City of Wichita Falls, the new pipeline increases the capacity by approximately 100 acre-feet.

Table 5-41 Red River Authority Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	0	0	0	0	0	51
Safe Supply Shortage	40	37	44	58	73	124
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	0	32	32	32	32	32
Treated Waterline[1]		100	100	100	100	100
Total	0	132	132	132	132	132
[1]This project will convert a raw water contract to treated water based on voluntary transfer of Wichita Falls conserved supply.						

Table 5-42 Red River Authority Capital and Annual Cost

Recommended Strategies	**Capital Cost**	**Annual Cost**					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	$0	$0	$35,130	$34,021	$4,245	$4,078	$3,962
Voluntary Transfer	$3,546,000	$0	$883,000	$883,000	$633,000	$633,000	$633,000
Total	$3,546,000	$0	$918,130	$917,021	$637,245	$637,078	$636,962

Windthorst WSC

Windthorst WSC's service area is located primarily in Archer County and the discussion of their recommended strategies can be found in Section 5.5.1.

Clay County Summary

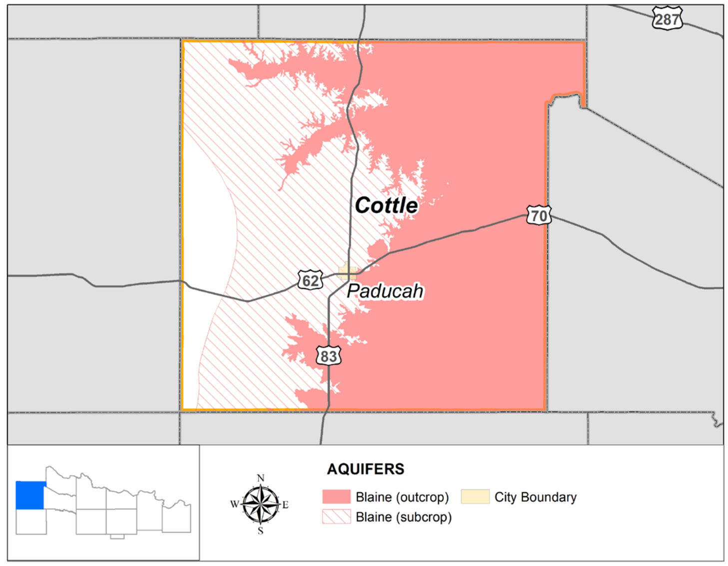
The maximum safe need for Clay County is 247 acre-feet per year A summary of the recommended strategies for Clay County is shown on Table 5-43.

Table 5-43 Clay County Recommended Strategies Summary

Water User	Strategy Description	Max Supply (ac-ft/yr)	Max Cost/ 1,000 gal	Implement Decade
County-Other	Water conservation	22	$1.26	2020
	Voluntary Transfer	70	$3.50	2020
Red River Authority	Water conservation	32	$3.37	2030
	Treated Waterline[1]	100	$5.08	2020
TOTAL		224		
ALTERNATE STRATEGIES – NONE IDENTIFIED				
[1]This project will convert a raw water contract to treated water				

5.5.4 Cottle County

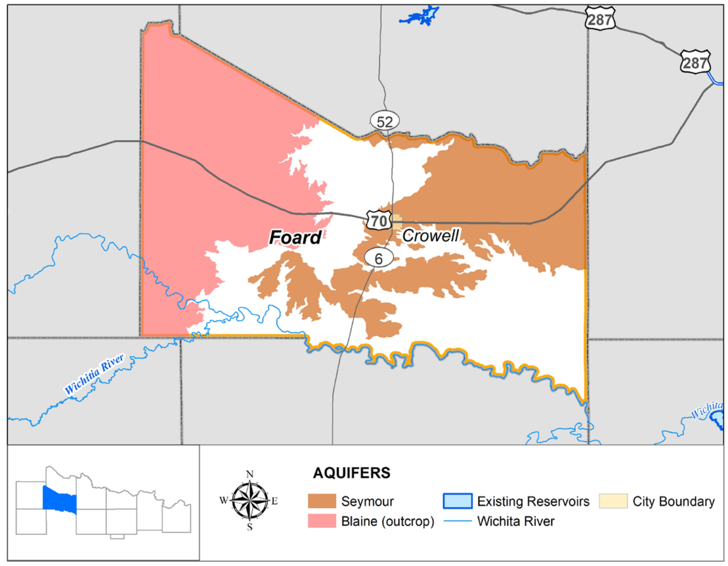
Cottle County is located in the far western portion of the Region B planning area. The population of Cottle County in 2010 was 1,505. The water supply in Cottle County is primarily groundwater from the Blaine Aquifer and other local aquifers. Some supplies for irrigation and livestock are from run-of-river supplies or stock ponds. There are no identified needs in Cottle County during the planning period.



Cottle County Summary

There are no projected water needs in Cottle County through the planning period.

5.5.5 Foard County



Foard County is located in the central portion of the Region B planning area. The population of Foard County in 2010 was 1,336. The water supply in Foard County is obtained from a variety of sources including Greenbelt Reservoir, the Seymour aquifer, the Blaine aquifer, other local aquifers, and stock ponds. There are small firm supply water needs in Foard County for the City of Crowell. The City of Crowell and County-Other have a total safe-supply need of approximately 50 acre-feet by the year 2070. This is associated with supply allocations from the Greenbelt MIWA. The MIWA has sufficient supplies to meet these needs.

<u>Crowell</u>

The City of Crowell purchases water from the Greenbelt MIWA. The MIWA will provide for all of Crowell's demands. The shortage shown for Crowell is the additional supply needed to meet the firm and safe supply demand. Greenbelt MIWA has sufficient supplies to meet these safe demands. The recommended strategy for Crowell is municipal conservation and obtaining additional supplies, if needed, from Greenbelt MIWA to meet the safe supply demand.

<u>Recommended Strategies:</u>

- Water Conservation (Section 5.3)
- Voluntary Transfer – This strategy would provide additional Supply from Greenbelt MIWA.

Summary of Recommended Strategies for Crowell

The recommended strategy for Crowell is water conservation and additional supplies from Greenbelt MIWA. Table 5-44 shows the need and recommended strategy to meet that need. The additional supplies from Greenbelt MIWA do not require any additional infrastructure and therefore have no capital costs. Annual cost represents the regional purchase price for treated water at an estimated rate of $3.50 per 1,000 gallons. Table 5-45 shows capital cost and the annual cost for the recommended strategy.

Table 5-44 Crowell Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	-	-	-	-	13	24
Safe Supply Shortage	-	-	-	26	39	50
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	1	3	3	4	5	6
Voluntary Transfer	0	0	0	22	34	44
Total	1	3	3	26	39	50

Table 5-45 Crowell Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	$0	$419	$1,039	$1,131	$1,577	$2,023	$2,514
Voluntary Transfer	$0	$0	$0	$0	$25,091	$38,776	$50,181
Total		$419	$1,039	$1,131	$26,668	$40,799	$52,695

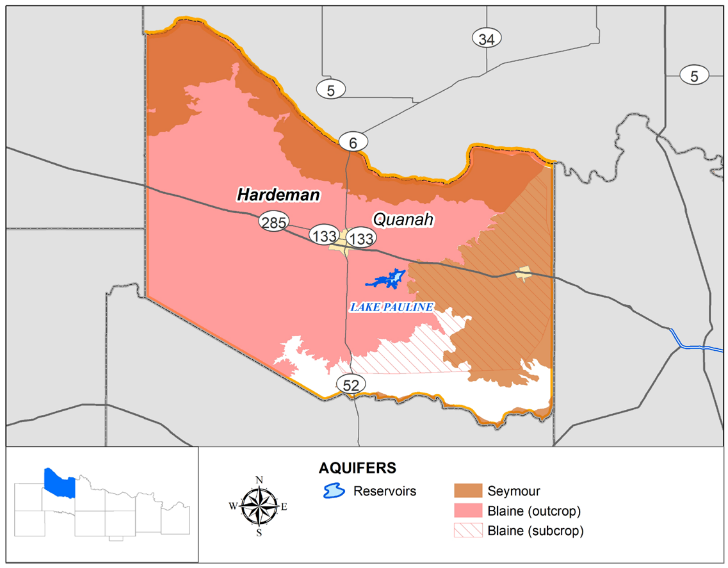
Foard County Summary

Foard County has sufficient supplies to meet its needs with only a small supply needs associated with the City of Crowell. Greenbelt MIWA Authority has sufficient supplies to meet the needs of Crowell including a safe need of 50 acre-feet per year in 2070. A summary of the recommended strategies for Foard County is shown on Table 5-46.

Table 5-46 Foard County Recommended Strategies Summary

Water User	Strategy Description	Max Supply (ac-ft/yr)	Max Cost/ 1,000 gal	Implement Decade
Crowell	Water Conservation	6	$1.29	2020
	Voluntary Transfer	44	$3.50	2050
TOTAL		50		
ALTERNATE STRATEGIES – NONE IDENTIFIED				

5.5.6 Hardeman County



Hardeman County is located in the northeastern portion of the Region B planning area. The population of Hardeman County in 2010 was 4,139 and its current population is approximately 4,274. The water supply in Hardeman County is supplied from a variety of sources including Greenbelt Reservoir, the Seymour aquifer, the Blaine aquifer, other local aquifers, run-of-river, and stock ponds. Water users including City of Quanah, Red River Authority of Texas, and manufacturing, all show to have needs through the planning period. These needs are associated with supply allocations from the Greenbelt MIWA. The MIWA has sufficient supplies to meet these needs. The total firm water need in Hardeman County is approximately 177 acre-feet by the year 2070 and a total safe water need of 391 acre-feet by the year 2070. Individual water user groups and their strategies are listed below.

<u>Quanah</u>

The City of Quanah purchases water from Greenbelt MIWA. The City also provides water to manufacturing use in Hardeman County. Both the City and Manufacturing have a small firm supply need beginning in 2060, in addition to a small safe supply needs early in the planning period. The recommended strategies for Quanah are municipal conservation and purchase additional water from Greenbelt MWIA.

Recommended Strategies:

- Water Conservation (Section 5.3)
- Voluntary transfer- This strategy would provide supplies from Greenbelt MIWA. Greenbelt MIWA is located in Region A and has sufficient current supplies to meet this safe supply need.

Summary of Recommended Strategies for Quanah

The recommended strategy for Quanah is water conservation and additional supplies from Greenbelt MIWA. Table 5-47 shows the need and recommended strategy to meet that need. The additional supplies from Greenbelt MIWA do not require any additional infrastructure and therefore have no capital costs. Annual cost represents the regional purchase price for treated water estimated at $3.50 per 1,000 gallons. Table 5-48 shows the annual cost for the recommended strategy.

Table 5-47 Quanah Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	-	-	-	-	36	76
Safe Supply Shortage	-	-	-	79	115	156
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	8	12	20	20	20	20
Voluntary Transfer				59	95	136
Total	8	12	20	79	115	156

Table 5-48 Quanah Capital and Annual Cost

Recommended Strategies	**Capital Cost**	**Annual Cost**					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water	$0	$3,168	$4,761	$8,179	$8,121	$7,814	$7,870
Voluntary Transfer	$0	$0	$0	$0	$67,288	$108,345	$155,105
Total	$0	$3,168	$4,761	$8,179	$75,409	$116,159	$162,975

<u>Manufacturing – Hardeman County</u>

Manufacturing purchases its water from Quanah. This user group shows a small firm water need beginning in 2060 in addition to safe supply needs beginning in 2030 and continuing through the end of the planning period. It is assumed that Quanah will provide this additional water, if needed, through additional supplies from Greenbelt MIWA.

Summary of Recommended Strategies for Manufacturing – Hardeman County

The recommended strategy for manufacturing in Hardeman County is additional supplies from Quanah. Table 5-49 shows the need and recommended strategy to meet that need. It is assumed that no new infrastructure is needed for this supply. Annual cost represent the regional purchase price for treated water estimated at approximately $3.50 per 1,000 gallons. Table 5-50 the annual cost for the recommended strategy.

Table 5-49 Manufacturing – Hardeman County Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	-	-	-	-	10	29
Safe Supply Shortage	-	52	52	90	107	126
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Voluntary Transfer	0	52	52	90	107	126

Table 5-50 Manufacturing – Hardeman County Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Voluntary Transfer	$0	$0	$59,305	$59,305	$102,643	$122,031	$143,700

Red River Authority

Red River Authority (RRA) purchases water from Greenbelt MIWA and provides water service to rural customers in Hardeman County. RRA shows to have firm supply needs of approximately 72 acre-feet per year beginning in 2050 and a maximum of 109 acre-feet per year of safe supply needs by 2070.

The strategies to meet these needs include water conservation and purchase of additional water as needed from Greenbelt MIWA at a rate of $3.50 per 1,000 gallons.

Table 5-51 Red River Authority Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	0	0	0	23	48	72
Safe Supply Shortage	0	1	13	56	83	109
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	0	13	14	14	16	16
Voluntary Transfer	0	0	0	42	67	93
Total	0	13	14	56	83	109

Table 5-52 Red River Authority Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	$0	$0	$14,272	$14,884	$1,857	$2,039	$1,981
Voluntary Transfer	$0	$0	$0	$0	$47,900	$76,412	$106,065
Total	$0	$0	$14,272	$14,884	$49,757	$78,451	$108,045

Hardeman County Summary

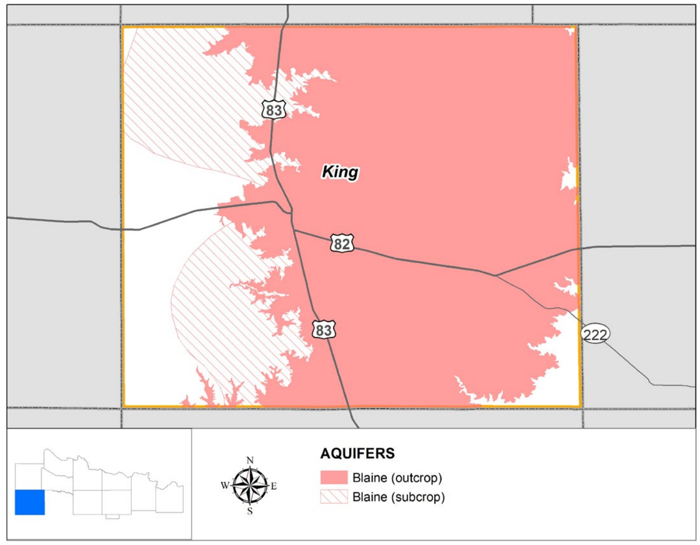
The maximum projected firm water need for Hardeman County is 177 acre-feet per year with all being associated with an irrigation supply shortage. Also, there is a safe supply need of 391 acre-feet per year for Quanah, Manufacturing, and Red River Authority. A summary of the recommended strategies for Hardeman County is shown on Table 5-53.

Table 5-53 Hardeman County Recommended Strategies Summary

Water User	Strategy Description	Max Supply (ac-ft/yr)	Max Cost/ 1,000 gal	Implement Decade
Quanah	Water Conservation	20	$1.26	2020
	Voluntary Transfer	136	$3.50	2050
Manufacturing	Voluntary Transfer	126	$3.50	2030
Red River Authority	Water Conservation	16	$3.37	2020
	Voluntary Transfer	93	$3.50	2050
TOTAL		391		
ALTERNATE STRATEGIES – NONE IDENTIFIED				

5.5.7 King County

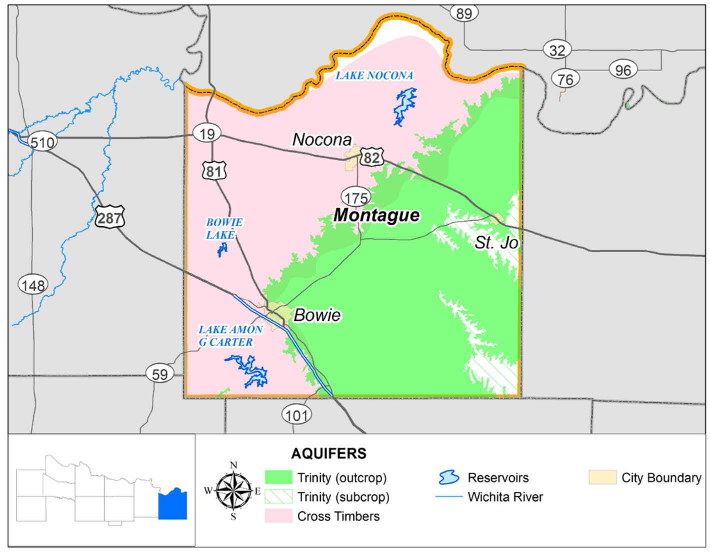
King County is located in the southwestern portion of the Region B planning area. The population of King County in 2010 was 286. The water supply in King County is supplied from the Blaine aquifer, other local aquifers, and stock ponds. There are no identified needs in King County during the planning period.



King County Summary

There are no projected water needs in King County through the planning period.

5.5.8 Montague County



Montague County is located in the north east portion of the Region B planning area. The population of Montague County in 2010 was 19,719, and currently has a population of approximately 20,057. The water supply in Montague County is from a variety of sources including Lake Amon Carter, Lake Nocona, the Trinity Aquifer, other local aquifers, run-of-river, stock ponds, and direct reuse for mining. The total safe-supply need in Montague County is approximately 546 acre-feet by the year 2070. Individual water user groups and their strategies are listed below.

<u>Bowie</u>

The recommended strategies for Bowie are municipal conservation, which is discussed in Section 5.3, and wastewater reuse. Table 5-54 shows the need and recommended strategies to meet that need. Bowie is expected to have firm supply needs beginning in 2040 and continuing through 2070. In addition, Bowie will have safe supply needs beginning in 2020 and continuing through 2070. With the reduction in water supply from Lake Amon Carter, it is anticipated that Bowie will have both firm and safe supply needs.

Along with conservation, an indirect wastewater reuse project is proposed which could provide up to 550 acre-feet per year of additional water supply from their wastewater treatment plant location north of Lake Amon Carter. The indirect reuse project includes a 6-inch pipeline from the existing wastewater treatment plant to Lake Amon Carter where it will be blended in the lake. Additional water treatment will be needed with 0.5 MGD water treatment plant expansion. Treated water will then be provided using the existing distribution system. Table 5-55 shows the capital cost and the annual cost for the recommended strategies.

Table 5-54 Bowie Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	-	-	17	110	208	305
Safe Supply Shortage	40	138	216	310	410	509
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	35	55	55	57	56	56
Wastewater Reuse	550	550	550	550	550	550
Total	585	605	605	607	606	606

Table 5-55 Bowie Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Conservation	$0	$14,142	$22,197	$21,964	$22,933	$22,359	$22,474
Wastewater Reuse	$5,123,000	$648,000	$648,000	$288,000	$288,000	$288,000	$288,000
Total	$5,123,000	$662,142	$670,197	$309,964	$310,933	$310,359	$310,474

Montague County - Other

Montague County-Other uses water purchased from the cities of Bowie and Nocona, and self-supplied groundwater. This water user has sufficient supplies to meet its needs but is shown to have a safe supply need. To meet this need, the recommended strategies for Montague County-Other is municipal conservation, which is discussed in Section 5.3, and purchase additional water from Bowie and/or Nocona. Since these entities already provide water to County-Other, it is assumed that no additional infrastructure is needed. Purchase water cost are estimated at $3.50 per 1,000 gallons. Table 5-56 shows the need and recommended strategy to meet that need. Table 5-57 shows capital cost and the annual cost for the recommended strategy.

Table 5-56 Montague County-Other Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	2030	2040	2050	2060	2070
Water Needs	-	-	-	-	-	-
Safe Supply Shortage	34	32	13	13	19	25
	Supply in Acre-Feet per Year					
Recommended Strategies	2020	2030	2040	2050	2060	2070
Water Conservation	11	25	37	44	63	63
Voluntary Transfer	23	7				
Total	34	32	37	44	63	63

Table 5-57 Montague County-Other Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	2030	2040	2050	2060	2070
Water Conservation	$0	$4,349	$10,066	$14,947	$17,443	$25,306	$25,306
Voluntary Transfer	$0	$26,231	$7,983	$0	$0	$0	$0
Total	$0	$30,580	$18,049	$14,947	$17,443	$25,306	$25,306

Nocona Hills WSC

Nocona Hills WSC provides water service to customers adjacent to Lake Nocona. Nocona Hills WSC has developed groundwater supply wells that can meet their firm water supply needs through 2070 and shows to have a very small safe supply need through the planning period.

It is anticipated that Nocona Hills WSC can meet their supply needs through water conservation, prior to developing additional groundwater supplies.

Table 5-58 Nocona Hills WSC Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	2030	2040	2050	2060	2070
Water Needs	0	0	0	0	0	0
Safe Supply Shortage	8	9	9	10	12	12
	Supply in Acre-Feet per Year					
Recommended Strategies	2020	2030	2040	2050	2060	2070
Water Conservation	1	2	3	3	5	6
Total	1	2	3	3	5	6
Nocona Hills WSC can meet all firm water supply needs through 2070, however they will have a small safe supply need of only 6 acre-feet in 2070 which could potentially be met by additional conservation.						

Table 5-59 Nocona Hills WSC Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	2030	2040	2050	2060	2070
Water Conservation	$0	$453	$797	$1,136	$1,321	1,809	$2,240

Mining - Montague County

Mining obtains water from groundwater and reuse from the City of Bowie. This user is projected to have a shortage in 2020. The recommended strategy for mining in Montague County is water conservation which is discussed in Section 5.3. A water conservation goal of 25 percent is established based on produced water reuse/recycle and use of alternative sources not suitable for other uses.

Summary of Recommended Strategies for Mining – Montague County

The recommended strategy for Montague County Mining is water conservation. Table 5-60 shows the need and recommended strategy to meet that need. No costs were developed for mining conservation.

Table 5-60 Mining - Montague County Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	1,291	226	257	-	-	-
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	910	644	402	173	194	194
Unmet Mining Needs	**381**	**0**	**0**	**0**	**0**	**0**

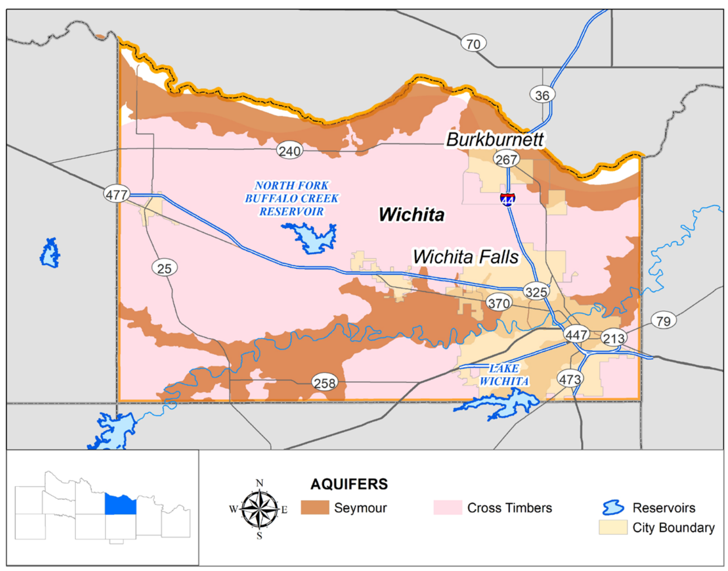
Montague County Summary

The maximum projected water firm need for Montague County is 1,291 acre-feet per year and the maximum safe need is 546 acre-feet per year. A summary of the recommended strategies for Montague County is shown on Table 5-61.

Table 5-61 Montague County Recommended Strategies Summary

Water User	Strategy Description	Max Supply (ac-ft/yr)	Max Cost/ 1,000 gal	Implement Decade
Bowie	Water Conservation	57	$1.24	2020
	Wastewater Reuse	550	$3.62	2020
County Other	Water Conservation	63	$1.24	2020
	Voluntary Transfer	23	$3.50	2020
Nocona Hills WSC	Water Conservation	6	$1.39	2020
Mining	Water Conservation	910	$7.67	2020
TOTAL		1,609		
Unmet Mining Need of 381 acre-feet per year in 2020.				
Unmet Safe Bowie Need of 90 acre-feet per year by2070.				
ALTERNATE STRATEGIES – NONE IDENTIFIED				

5.5.9 Wichita County



Wichita County is located in the north central portion of the Region B planning area. The population of Wichita County in 2010 was 131,500, and its current population is approximately 135,627. Most of the municipal water supply in Wichita County is supplied by Wichita Falls. Irrigation supplies are provided from Lake Kemp through a series of canals owned and operated by the WCWID No. 2. Some Seymour aquifer and local groundwater supplies are used by municipal users, livestock and manufacturing. The total safe-supply need in Wichita County is approximately 39,085 acre-feet by the year 2070. Individual water user groups and their strategies are listed below. For the municipal water user groups, the recommended strategies include water conservation, fulfillment of existing contracts, and voluntary transfer from Wichita Falls.

Electra

Electra has a pass-through contract with Iowa Park to receive 841 acre-feet per year of treated water from Wichita Falls. It also has a groundwater well field in the Seymour aquifer, which is used during drought. The City has a projected firm shortage of 395 acre-feet per year by 2070 and a safe supply shortage of 587 acre-feet per year. The recommended strategies for Electra include water conservation, fulfillment of the existing contract from Wichita Falls, and an increase in the Wichita Falls contract to provide a safe supply.

Recommended Strategies:

- Water Conservation (Section 5.3)
- Fulfillment of Existing Contract with Wichita Falls - This strategy would provide for the full contracted supply and meet the projected needs.
- Voluntary Transfer from Iowa Park (Wichita Falls Contract).

Summary of Recommended Strategies for Electra

The recommended strategies for Electra of water conservation and the existing contract from Wichita Falls through Iowa Park are sufficient to meet the safe supply shortages. Table 5-62 shows the need and recommended strategies to meet that need. Since Electra has an existing contract with Wichita Falls and the existing infrastructure is sufficient to deliver the full contracted amount, there are no costs associated with fulfillment of the contractual obligations. Increased supplies are estimated at $5.00 per 1,000 gallons of treated water. Table 5-63 shows capital cost and the annual cost for the recommended strategies.

Table 5-62 Electra Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	133	164	202	246	290	395
Safe Supply Shortage	310	344	385	432	479	587
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	9	17	29	38	47	48
Fulfillment of Existing Contract with Wichita Falls	0	0	41	70	104	206
Voluntary Transfer from Iowa Park (Wichita Falls Contract)	124	147	315	324	328	333
Total	133	164	385	432	479	587

Table 5-63 Electra Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	2030	2040	2050	2060	2070
Water Conservation	$0	$3,551	$6,647	$11,608	$15,137	$18,898	$19,175
Voluntary Transfer from Iowa Park (Wichita Falls Contract)	$0	$202,028	$239,500	$513,215	$527,879	$534,396	$542,542
Total	$0	$205,579	$246,147	$524,823	$543,016	$553,294	$561,717

Harrold WSC

Harrold WSC service area is primarily in Wilbarger County, and the discussion of their recommended strategies and costs will be addressed as part of Wilbarger County.

Iowa Park

Iowa Park has a treated water contract with Wichita Falls to supply 1,400 acre-feet per year directly to Iowa Park, 841 acre-feet per year to Electra, and 675 acre-feet to Wichita Valley WSC. The recommended strategies for Iowa Park include water conservation and fulfillment of the existing contract from Wichita Falls.

Recommended Strategies:

- Water Conservation (Section 5.3)
- Fulfillment of Existing Contract from Wichita Falls - This strategy would provide for the full contracted supply from Wichita Falls.

Summary of Recommended Strategies for Iowa Park

The recommended strategies for Iowa Park of water conservation and the existing contract from Wichita Falls are sufficient to meet the safe supply shortages. Table 5-64 shows the need and recommended strategies to meet that need. Since Iowa Park has an existing contract with Wichita Falls and the existing infrastructure is sufficient to deliver the full contracted amount, there are no costs associated with fulfillment of the contractual obligations. Table 5-65 shows no capital cost and the annual cost for the recommended strategies.

Table 5-64 Iowa Park Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	2030	2040	2050	2060	2070
Water Needs	-	-	-	-	-	35
Safe Supply Shortage	-	-	-	-	62	217
	Supply in Acre-Feet per Year					
Recommended Strategies	2020	2030	2040	2050	2060	2070
Water Conservation	11	25	30	41	47	47
Fulfillment of Existing Contract with Wichita Falls	0	0	68	117	174	343
Total	11	45	98	158	221	390

Table 5-65 Iowa Park Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	2030	2040	2050	2060	2070
Water Conservation	$0	$4,545	$9,943	$12,084	$16,295	$18,762	$18,928

Wichita Falls

Wichita Falls is both a wholesale supplier to customers in the region and provider to the City of Wichita Falls. A detailed discussion of the strategies for Wichita Falls are included in Section 5.4.1

Sheppard Air Force Base

Sheppard Air Force Base (AFB) is a United States Air Force based located within the northern city limits of Wichita Falls. Currently the Base population is approximately 6,088 and its population is counted as a part of the Wichita Falls total population.

Sheppard is showing a firm supply shortage beginning in 2030 and a safe supply shortage in 2020 through 2070. These needs will be met by the City of Wichita Falls and the recommended strategies include water conservation and fulfillment of existing contract with Wichita Falls as shown in Table 5-66 below.

Table 5-66 Sheppard AFB Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	-	14	45	29	70	225
Safe Supply Shortage	152	204	231	213	253	408
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	11	17	29	39	44	44
Fulfillment of Existing Contract with Wichita Falls	0	0	202	174	209	364
Total	11	17	231	213	253	408

Table 5-67 Sheppard AFB Need and Recommended Strategies

Recommended Strategies	Capital Cost	Annual Cost					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	$0	$4,256	$6,695	$11,534	$15,717	$17,645	$17,645

Irrigation – Wichita County

Irrigation is projected to have a shortage of 29,476 acre-feet per year by 2070. Much of this shortage is associated with reduced supplies from the Lake Kemp/Diversion system. Strategies developed by the WCWID No. 2 to reduce losses in the irrigation canals will provide additional water to irrigation users of this system. The recommended strategy for irrigation in Wichita County is agricultural conservation which is discussed in Section 5.4.2 as part of the conservation that could be achieved by the WCWID No. 2.

Summary of Recommended Strategies for Irrigation-Wichita County

The recommended strategy for irrigation in Wichita County is water conservation. Table 5-68 shows the need and recommended strategy to meet that need. The capital cost and the annual cost for the canal replacement project are shown for WCWID No. 2. Costs for the CCP are discussed in Section 5.5.12.

Table 5-68 Irrigation – Wichita County Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	20,695	22,452	24,208	25,964	27,720	29,476
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	830	2,488	4,048	8,575	10,809	13,829
Chloride Control – RRA	5,800	5,220	4,640	4,060	3,480	2,900
Total	6,630	7,708	8,688	12,635	14,289	16,729
Unmet Water Needs	**14,065**	**14,744**	**15,520**	**13,329**	**13,431**	**12,747**

Manufacturing – Wichita County

The recommended strategies for manufacturing in Wichita County include water conservation and fulfillment of the existing contracts from Wichita Falls customers. While there are site specific and unique opportunities for water conservation in the manufacturing sector, a specific water conservation goal is not established. The region encourages all water users to conserve water.

Recommended Strategies:

- Fulfillment of Existing Contract from Wichita Falls - This strategy would provide for the full contracted supply from Wichita Falls. The evaluation of the recommended strategies for Wichita Falls are discussed in Section 5.4.1

Summary of Recommended Strategies for Manufacturing -Wichita County

The recommended strategy for manufacturing in Wichita County is fulfillment of existing contracts from Wichita Falls customers. No costs are assessed to fulfill existing contract amounts. Table 5-69 shows the need and recommended strategy to meet that need.

Table 5-69 Manufacturing – Wichita County Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	-	-	-	-	3	103
Safe Supply Shortage	253	321	350	380	413	513
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
By Contract	0	0	350	380	413	513
Total	0	0	350	380	413	513

Steam Electric – Wichita County

The steam electric power water needs are associated with the water needs for Wichita Falls. Once Wichita Falls develops strategies, these needs will be met. The recommended strategies for steam electric power generation in Wichita County is water conservation. While a specific water conservation target for steam electric is not established, it is recognized that this use category may be able to identify unique water conservation opportunities. The region encourages all water users to conserve water.

Summary of Recommended Strategies for Steam Electric -Wichita County

The recommended strategy for steam electric power in Wichita County is water conservation. Table 5-70 shows the need and recommended strategy to meet that need.

Table 5-70 Steam Electric – Wichita County Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	-	1	2	2	4	7
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	3	4	5	6	7	10

Wichita County Summary

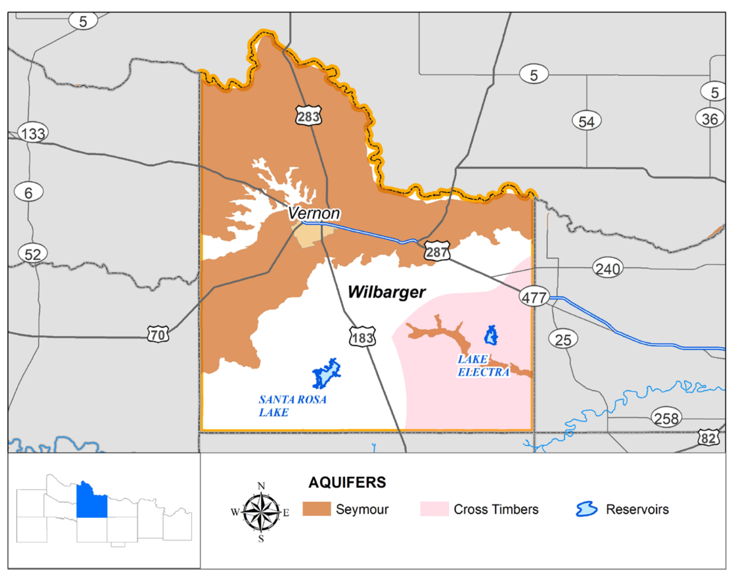
The maximum projected firm water need for Wichita County is 34,580 acre-feet per year with most of this need (29,476 acre-feet per year) associated with an irrigation supply shortage. The safe need for Wichita County is 39,085 acre-feet per year. Most of the needs in the county will be met through strategies developed by Wichita Falls and WCWID No. 2. A summary of the recommended strategies is presented in Table 5-71.

Table 5-71 Wichita County Recommended Strategies Summary

Water User	Strategy Description	Max Supply (ac-ft/yr)	Max Cost/ 1,000 gal	Implement Decade
Electra	Water Conservation	48	$1.23	2020
	By Contract	206	NA	2030
	Voluntary Transfer	333	$5.00	2020
Iowa Park	Water Conservation	47	$1.27	2020
	By Contract	343	NA	2030
Wichita Falls	Water Conservation	884	$1.23	2020
	Lake Ringgold	23,450	$4.59	2040
Sheppard AFB	Water Conservation	44	$1.24	2020
	By Contract	364	NA	2020
Irrigation	Water Conservation	13,829	$0.17	2020
	Chloride Control Project	5,800	N/A	2020
Manufacturing	By Contract	513	NA	2020
Steam Electric	Water Conservation	10	NA	2020
TOTAL		45,871		
Unmet Irrigation Need over planning period, with a maximum of 15,520 acre-per year by 2070.				
ALTERNATE STRATEGIES – NONE IDENTIFIED				

5.5.10 Wilbarger County

Wilbarger County is located in the north central portion of the Region B planning area. The population of Wilbarger County in 2010 was 13,535, and currently the population is approximately 14,464. The water supply in Wilbarger County is supplied from a variety of sources including the Seymour Aquifer, Lake Kemp for Steam Electric Power, other local aquifers, run-of-river, stock ponds, and Santa Rosa Lake. Each of these sources are fully allocated to existing users, which leaves few options for the development of new water. Considering the limitations of water availability in the county, the total safe-supply need in Wilbarger County is approximately 5,434 acre-feet by the year 2070. Individual water user groups and their strategies are listed below.



Harrold WSC

Harrold WSC is a rural water supply corporation located just west of the City of Electra in Wilbarger County. Harold WSC serves a population of approximately 376, and has a firm need in 2020 of 16 acre-feet per year and a safe need of 73 acre-feet per year by 2070.

Strategies to meet these needs include water conservation and the purchase of water from the City of Electra at a rate of $5.00 per 1,000 gallons

Table 5-72 Harrold WSC Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	16	20	25	30	35	49
Safe Supply Shortage	37	42	48	53	58	73
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	1	2	3	4	6	6
Voluntary Transfer from Electra	36	40	45	49	52	67
Total	37	42	48	53	58	73

Table 5-73 Harrold WSC Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	$0	$451	$859	$1,287	1,798	$2,305	$2,398
Voluntary Transfer	$0	$58,653	$65,170	$73,316	$79,833	$84,721	$109,160

Red River Authority

Red River Authority provides water services to the rural customers in Wilbarger County, that are located outside the city limits of incorporated entities, through their Hinds-Wildcat Water System. This system serves a population of approximately 1,050 and shows to have a safe water supply shortage of 5 acre-feet per year by 2070.

Strategies to meet this need will be water conservation.

Table 5-74 Red River Authority Needs and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Safe Supply Shortage	0	0	0	0	0	5
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	0	25	27	29	31	33
Total	0	25	27	29	31	33

Table 5-75 Red River Authority Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	$0	$0	$27,446	$28,705	$3,847	$3,951	$4,086

Vernon

The City of Vernon provides water to its residents, rural customers (RRA and others), and manufacturing in Wilbarger County. Vernon obtains its water supplies from several well fields in the Seymour aquifer. There is a main transmission line from these well fields to the City that was recently found to be losing water. The City shows a water shortage beginning in 2070 and a safe supply shortage in 2020. The safe supply shortages for Vernon and its customers total over 700 acre-feet per year by 2070. The options available for Vernon include municipal conservation, wastewater reuse and additional groundwater. Municipal conservation is discussed in Section 5.3, including discussion on water loss reductions associated with the repair/replacement of the transmission pipeline from the City's well field.

Summary of Recommended Strategies for Vernon

The recommended strategies for Vernon are water conservation and additional wells. Table 5-76 shows the need and recommended strategy to meet that need. Table 5-77 shows capital cost and the annual cost for the recommended strategies.

Table 5-76 Vernon Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	-	-	-	-	-	45
Safe Supply Shortage	280	470	515	608	684	754
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation (Vernon)	0	313	337	362	389	415
Additional Wells - Seymour Aquifer	600	600	600	600	600	600
Total	600	913	937	962	989	1,015

Table 5-77 Vernon Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	$8,800,000	$0	$0	$9,681	$19,776	$30,246	$40,986
Additional Wells - Seymour Aquifer	$1,115,000	$240,000	$240,000	$240,000	$162,000	$162,000	$162,000
Total	**$9,915,000**	**$240,000**	**$240,000**	**$249,681**	**$181,776**	**$192,246**	**$202,986**

Manufacturing – Wilbarger County

The recommended strategy for manufacturing in Wilbarger County is purchase water from Vernon. This strategy is discussed under the City of Vernon.

Summary of Recommended Strategies for Manufacturing - Wilbarger County

Table 5-78 shows the need and recommended strategy to meet that need. The costs for the recommended strategy is shown with the City of Vernon. Most of the water from Vernon is expected to come from groundwater.

Table 5-78 Manufacturing – Wilbarger County Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	-	-	-	-	-	13
Safe Supply Shortage	192	210	210	210	210	223
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Purchase from Vernon	192	210	210	210	210	223

Steam Electric – Wilbarger County

Steam electric power generation in Wilbarger County is associated with the Oklaunion Power Plant, which relies on Lake Kemp for its supplies. The recent drought has reduced the reliable supply from Lake Kemp and created a need. Options for additional water are limited in Wilbarger County. Previous investigations into local brackish groundwater found that the quantity was limited and the TDS levels were very high. The most likely option would be to retrofit the facility for alternative cooling technology. Other existing supplies in Wilbarger County are already fully allocated.

Summary of Recommended Strategies for Steam Electric - Wilbarger County

The recommended strategy for steam electric power generation in Wilbarger County is water conservation. Table 5-79 shows the need and recommended strategy to meet that need. Table 5-80 shows the capital cost and the annual cost for the recommended strategy.

Table 5-79 Steam Electric – Wilbarger County Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	2030	2040	2050	2060	2070
Water Needs	1,701	2,302	2,903	3,504	4,105	4,706
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Alternative Cooling Technology	0	2,302	2,903	3,504	4,105	4,706
Unmet Need	1,701	0	0	0	0	0

Table 5-80 Steam Electric – Wilbarger County Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost (millions)					
		2020	2030	2040	2050	2060	2070
Alternative Cooling Technology	$101,500,000		$5.50	$5.50	$1.26	$6.75	$6.75

Wilbarger County Summary

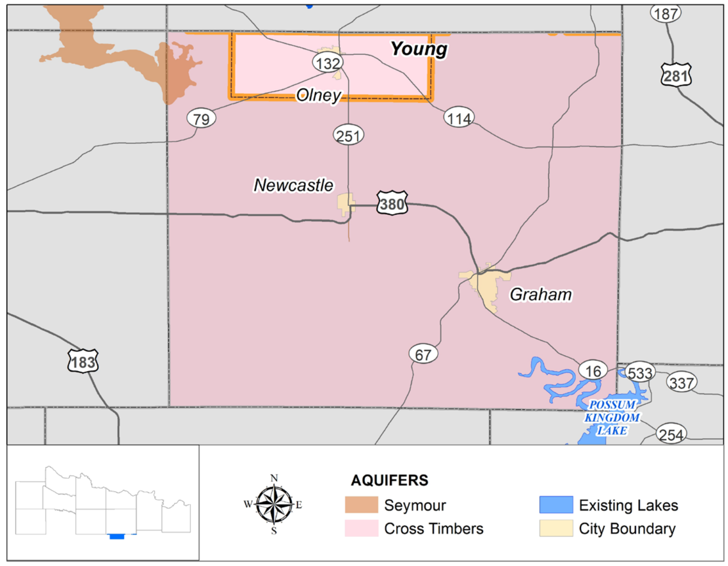
The maximum projected safe need for Wilbarger County is 5,434 acre-feet per year, with most of that safe need (4,706 acre-feet per year) being associated with steam electric power.

Wilbarger County has limited water supplies available for water management strategies. As a result, the only option for steam electric power is alternative cooling technology. Water conservation, direct reuse and developing additional wells for Vernon are the recommended strategies for Wilbarger County. These strategies are summarized in Table 5-81.

Table 5-81 Wilbarger County Recommended Strategies Summary

Water User	Strategy Description	Max Supply (ac-ft/yr)	Max Cost/1,000 gal	Implement Decade
Harrold WSC	Conservation	6	$1.38	2020
	Voluntary Transfer (Electra)	67	$5.00	2020
Red River Authority	Conservation	33	$3.37	2020
Vernon	Conservation	415	$1.24	2030
	New Groundwater	600	$1.23	2020
Manufacturing	Voluntary Transfer (Vernon)	223	NA	2020
Steam Electric	Alternative Cooling	4,706	$9.93	2020
TOTAL		6,050		
Unmet Steam Electric Power Need in 2020 of 1,701 acre-feet				
ALTERNATE STRATEGIES – NONE IDENTIFIED				

5.5.11 Young County



Young County is located in the south central portion of the Region B planning area. A portion of the county, which includes the City of Olney, is included in Region B while the remainder of the county is located in the Brazos G Planning Area. The total population of Young County in 2010 was 18,550, with 3,746 located in the Region B portion. Currently, the population located in Region B is approximately 3,904. The water supply in Young County is supplied from Lake Olney/Cooper, Wichita Falls, and other local aquifers. There is a small firm need to Olney in 2070 and only a safe supply need identified for Young County-Other during the planning period.

<u>Young County - Other</u>

The recommended strategies for Young County-Other are municipal conservation which is discussed in Section 5.3 and voluntary transfer of water from Olney at a rate of $3.50 per 1,000 gallons.

Summary of Recommended Strategies for Young County-Other

Table 5-82 shows the need and recommended strategy to meet that need and Table 5-83 shows capital cost and the annual cost for the recommended strategies.

Table 5-82 Young County-Other Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	2030	2040	2050	2060	2070
Safe Supply Shortage	8	10	12	13	15	16
	Supply in Acre-Feet per Year					
Recommended Strategies	2020	2030	2040	2050	2060	2070
Water Conservation	0	1	2	4	4	4
Voluntary Transfer from Olney	8	10	12	13	15	16
Total	8	11	14	17	19	20

Table 5-83 Young County-Other Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	2030	2040	2050	2060	2070
Water Conservation	$0	$148	$474	$982	$1,409	$1,512	$1,701
Voluntary Transfer from Olney	$0	$9,352	$11,633	$13,230	$15,054	$16,879	$18,704
Total	$0	$9,500	$12,107	$14,212	$16,463	$18,391	$20,405

Olney

The City of Olney has an identified firm supply shortage in 2070, and a safe supply shortage beginning in 2050. At one time Olney considered an indirect wastewater reuse project to convey wastewater from their plant into Lake Cooper. However, that project appears to be on indefinite hold. Olney does have an existing raw water line from Lake Kickapoo that could (with City of Wichita Falls approval) be used to convey raw water into the City of Olney Water Treatment Plant and meet the water supply needs of Olney. Estimated cost for this raw water is estimated to be approximately $2.50 per 1,000 gallons.

Table 5-84 Olney Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	2030	2040	2050	2060	2070
Water Needs	-	-	-	-	-	56
Safe Supply Shortage	-	-	-	34	83	179
	Supply in Acre-Feet per Year					
Recommended Strategies	2020	2030	2040	2050	2060	2070
Water Conservation	122	152	142	140	141	145
Voluntary Transfer	0	0	0	4	60	150
Total	122	152	142	144	201	295

Table 5-85 Olney Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	2030	2040	2050	2060	2070
Water Conservation	$0	$48,755	$60,806	$56,938	$56,084	$56,524	$57,903
Voluntary Transfer	$0	$0	$0	$0	$3,259	$48,878	$122,194
Total	$0	$48,755	$60,806	$56,938	$59,343	$105,402	$180,097

Young County Summary

The maximum projected water need for Young County is 56 acre-feet per year and a safe need of 195 acre-feet per year. The City of Olney has in place a 10" raw water line from Lake Kickapoo to Olney that could be utilized to shore up its supplies in Lakes Olney-Cooper. With this additional water, Olney would have sufficient supplies to meet the small County-Other needs identified in the Region B portion of Young County. A summary of the recommended strategies is shown in Table 5-86.

Table 5-86 Young County Recommended Strategies Summary

Water User	Strategy Description	Max Supply (ac-ft/yr)	Max Cost/ 1,000 gal	Implement Decade
County Other	Water Conservation	4	$1.51	2030
	Voluntary Transfer	16	$3.50	2030
Olney	Water Conservation	152	$1.23	2020
	Voluntary Transfer	150	$2.50	2050
TOTAL		322		
ALTERNATE STRATEGIES – NONE IDENTIFIED				

5.5.12 Regional Strategies

Red River Chloride Control Project

The concentration of dissolved salts, particularly chloride, in some surface waters in Region B limits the use of these waters for municipal, industrial, and agricultural purposes. The Red River Authority of Texas is the local sponsor and has been working in cooperation with the U.S. Army Corps of Engineers (USACE) for a number of years on a project to reduce the chloride concentration of waters in the Red River Basin. The successful completion of this project would result in an increase in the volume of water available for municipal and industrial purposes in Region B and water would be available for a broader range of agricultural activities. Therefore, the Chloride Control Project (CCP) is included in the Regional Water Plan as one of the feasible strategies for meeting the water supply needed in Region B. Following is a summary of the CCP that presents the background of the project, the components, and current status of the project, and an analysis of the CCP as a regional water resource strategy.

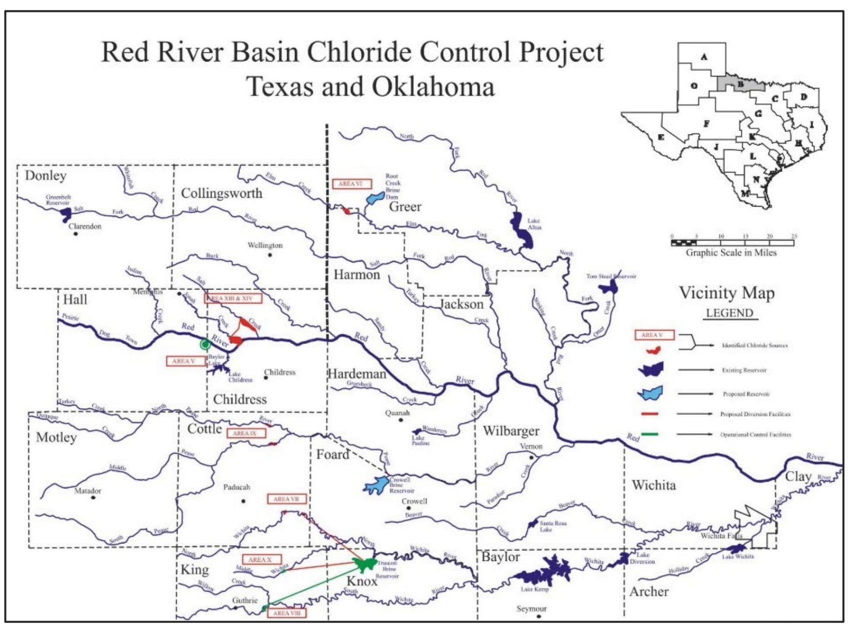
Background

In 1957, the U.S. Public Health Service initiated a study to locate the natural sources that contribute high concentrations of chloride to surface waters in the Red River Basin. It was determined that ten natural salt source areas in the basin contributed approximately 3,300 tons of chloride each day to the Red River.

In 1959, the USACE performed a study to identify control measures for these salt sources. Subsequently, structural measures were recommended for eight source areas.

Description of the Chloride Control Project

The primary strategy to reduce the flow of highly saline waters to the Red River is to impound these flows behind low flow dams and pump the saline waters to off-channel brine reservoirs where the water evaporates or is disposed of by deep-well injection. During high-flow periods, when the chloride concentration is lower, waters flow over the low dams and proceed downstream.



There are four saline inflow areas that impact water quality in Region B:

- Areas VII, VIII, and X affect the quality of water in the Wichita River including Lake Kemp and Lake Diversion.

- Area IX affects the quality of waters in the Pease River, including the proposed Pease River Reservoir.

Construction of the chloride control facilities at Area VIII on the South Fork of the Wichita River in King County and Knox County was authorized in 1974. These facilities include a low flow dam near Guthrie, Texas, with a deflatable weir to collect the saline inflows; the Truscott Brine Reservoir near Truscott, Texas; and, a pump station and pipeline to transport the saline water from the impoundment at Guthrie to the Truscott Brine Reservoir. These facilities have been in operation since May 1987. Construction of the facilities at Area X was initiated in 1991, but they have not been completed due to a decision to modify the design of these facilities, a change to the brine disposal area, and a need to address environmental issues identified by the U.S. Fish and Wildlife Service (USFWS) and the Texas Parks and Wildlife Department (TPWD). A Final Environmental Statement (FES) was prepared for the project and published in 1977. A supplement to the FES (SFES) and an Economic evaluation of the project were completed for the Wichita Basin in 2003. These studies found that the Wichita Basin CCP is economically and environmentally feasible and the Record of Decision was signed in March 2004. Construction of the facilities for Areas X and VII are waiting for budget approval.

The effectiveness and environmental impacts of the project will be evaluated as the CCP facilities are completed and operating within the Wichita River Basin. The results of this effort will be used to determine if and, if so, how CCP facilities will be provided for Area IX on the Pease River. The potential Pease River Reservoir would not be viable for a municipal water supply without completion of the CCP for the Pease River Basin.

Because of the improved water quality resulting from implementation of the CCP, it has been identified as a feasible supply alternative for Region B. Following is an evaluation of the quantity and quality of water that would be provided; the reliability of the supply; the cost to distribute, treat, or convey the water; potential impacts on the environment and agriculture in the area; the regulatory and political acceptability of, and public support for, the project; and the extent to which this strategy could affect other strategies. This evaluation addresses the completion of the CCP in the Wichita Basin. When the scheduling for the Pease River Basin phase of the project is more certain, the regional plan should be amended to include an evaluation of the effects of the Pease River phase of the project on water resources in Region B.

Water Quantity, Reliability and Cost

While no additional water is directly made available through this strategy, there would be water savings realized through the reduction in water losses associated with advanced water treatment for municipal use and more efficient applications of irrigation water. The estimate of these water savings is approximately 5,800 acre-feet per year in 2020 (20 percent of the safe yield), reducing over time as supplies from Lake Kemp decline. The Corps of Engineers estimated the remaining construction cost to complete the project is $59,371,000[4] ($69,430,000 in September 2018). It should also be noted that the cost impacts of the CCP on residents of Region B and the State of Texas are different than the cost impacts of membrane treatment or other supply strategies. The capital costs of the CCP facilities will be funded with federal monies.

Environmental Factors

The project will improve the overall water quality in the Wichita River Basin, which is considered a benefit to the environment. As previously discussed, environmental impact studies have been for this project. The environmental issues that have been identified are summarized below:

- Selenium (Se) is a naturally occurring element in soils in the western United States and in the waters of the CCP project area. Se in trace amounts is an essential dietary component. However, it has been concluded that, in higher concentrations in water and sediment, Se adversely impacts aquatic birds in some areas of the country. Concern has been expressed that the concentration of Se in the brine disposal reservoirs will increase due to evaporation and pose a threat to local and migratory birds, fish, and wildlife. Data collected at the Truscott Brine Reservoir have found no increases in Selenium concentrations following 11 years of operation and Selenium is not expected to result in excessive risk at the Brine Lake.

- Small decreases in flows are projected to occur in the Wichita River and the Red River between the Wichita River confluence and Lake Texoma. These flow decreases will result from the diversion of low flows to the brine disposal reservoirs and increased use of the river flow for irrigation when the quality improves. Changes in water quality and quantity could impact the composition of vegetation along these river reaches and result in vegetative encroachment on the stream channel. There is a concern that decreased flows and changes in vegetative composition could adversely affect the habitat for aquatic life, birds, and wildlife. These changes are expected to be low to moderate and potential impacts are addressed in the monitoring and mitigation plan for the project.

- There is a concern that wetlands in the Red River flood plain will be adversely impacted as a result of both changes in the hydrologic regime and the conversion of land adjacent to the river to cropland and pasture. These potential impacts are also addressed in the monitoring and mitigation plan for the CCP.

- Concern has been expressed that the reduction in the TDS concentration in Lake Texoma, associated changes in physical characteristics of the lake (turbidity), a decrease in primary production rates due to a decrease in the depth of the eutrophic zone, and alterations in nutrient cycling will reduce the sport fish harvest in the lake, and may affect the aesthetic quality of the lake. Studies have shown that the changes in TDS concentration in Lake Texoma associated with the Wichita River CCP are expected to have negligible adverse impacts to fisheries or aesthetics to the lake.

Each of these issues was addressed in the SFEIS, and the report concludes there will not be significant impacts in most cases. Where potential impacts have been identified, mitigation and monitoring measures are proposed.

Several state and federally listed threatened and endangered species are present in, or migrate through, the project area. To address concerns related to the bald eagle, whooping crane, and least tern, in 1994 the USFWS and USACE agreed upon a Biological Opinion that defines Reasonable and Prudent Measures to protect these species. These measures are described in Supplement I to the SFES.

Impacts on Water Resources and Other Water Management Strategies

The CCP should have a positive impact on water resources and other water management strategies. This strategy is considered a demand reduction strategy, which would result in lower demands on other water management strategies.

Impacts on Agriculture and Natural resources

This project will have a positive impact on agriculture and natural resources by improving the water quality in the Wichita River Basin. The improvements in the quality of water will allow the water to be used to irrigate a wider variety of crops and reduce the potential for salt build-up in soils.

Other Relevant Factors

The brine will be stored in impoundment facilities similar to the Truscott Brine Lake. The water supply source that will be enhanced by the Wichita Basin CCP is the Lake Kemp/Diversion system. As previously described in Chapter 3 of the Region B Water Plan, the firm yield of this system is estimated at 44,000 acre-feet per year in 2020, and 22,800 acre-feet per year in 2070. The yield decrease, which is attributable to sedimentation, is expected to be mitigated through an increase in the water conservation elevation and use of a seasonal pool during the irrigation months. Benefits of the CCP would be applicable to all waters stored in the Lake Kemp/Diversion system.

The political acceptability of the project varies depending on the sector of the community. Municipalities, industries, and the agricultural community are supportive of the project. The degree of support for the project is evidenced by the congressional approval and funding of the project in bills enacted in 1962, 1966, 1970, 1974, 1976, and 1986. In 1988, a special panel created by the Water Resource Development Act of 1986 issued a report favorable to the project.

The natural resource agencies, Lake Texoma sport fishermen, and related lake businesses have expressed opposition to the project. However, substantial progress has been made in addressing the natural resource and fishing concerns.

LIST OF REFERENCES

1 Freese and Nichols and Biggs and Mathews, Long-Range Water Supply Plan prepared for the City of Wichita Falls, January 2015 and Revised January 2016.

2 Freese and Nichols, Proposed Lake Ringgold Feasibility Study prepared for the City of Wichita Falls, October 2013

3 Freese and Nichols, Report Supporting Application for Lake Ringgold prepared for the City of Wichita Falls, May 2017

4United State Corps of Engineers, Red River Chloride Control Project, Texas and Oklahoma; Fact Sheet, February 6, 2012.

ATTACHMENT 5-1

METHODOLOGY IDENTIFYING POTENTIALLY FEASIBLE WATER MANAGEMENT STRATEGIES

2021 FINAL PLAN

REGION B

OCTOBER 2020

Methodology
Identifying Potentially Feasible Water Management Strategies

Region B
2021 Water Plan

Feasible Strategies

From TAC 357.12b

"A RWPG shall hold a public meeting to determine the process for identifying potentially feasible water management strategies; the process shall be documented and shall include input received at a public meeting; ..."

Feasible Strategies

- Considerations
  - A strategy must use proven technology
  - A strategy should be appropriate for regional planning
  - A strategy should have an identifiable sponsor
  - Must consider end use. Includes water quality, economics, geographic constraints, etc.
  - Must meet existing regulations

Feasible Strategies by Type

- Water conservation
  - Review for applicability and consider for all WUGs with a need
  - Consider water conservation for all municipal WUGs with gpcd > 140
- Drought management
  - Emergency measures
  - Generally, not recommended for long-term water supply

Feasible Strategies by Type

- Expanded use of existing supplies
  - New groundwater wells
    - Consider groundwater availability
  - Conjunctive use of groundwater & surface water
  - New infrastructure
  - Aquifer storage and recovery
- Voluntary transfer
  - Contracts
  - Sales, leases and options
  - Interbasin transfers of surface water

Feasible Strategies by Type

- New water supplies
  - Surface water (reservoirs and new diversions)
  - Groundwater (new well fields)
- Wastewater reuse
  - Update based on current practices and planned implementation
    - Identify opportunity for expansion
  - Identify generators of wastewater and potential new recipients for reuse

Feasible Strategies by Type

- Desalination of brackish water
  - Includes both groundwater and surface water sources
- Emergency Transfer of Water
- Yield enhancement
  - Brush management
  - Recharge enhancement
- Water quality enhancements
  - Chloride Control Project

Strategies Not Appropriate for Region B

- Rainwater harvesting
- Cancellation of water rights

Identification Process

- Identify entities with needs
- Review recommended strategies in 2016 plan
- Identify potential new or changed strategies
  - Assess feasibility by strategy type
- Contact entity for input
  - Contact RWPG representative for county-wide WUGs
- Verify recommendations

Evaluations

- Quantity, cost and reliability
- Environmental factors
- Impacts on water resources and other WMS
- Impacts on agriculture/ rural
- Impacts on natural resources
- Impacts on key water quality parameters
- Other relevant considerations

Alternative Strategies

- Selected with entity input
- Evaluated using same considerations for selected strategies

ATTACHMENT 5-2

WMS CONSIDERED AND EVALUATED

2021 FINAL PLAN

REGION B

OCTOBER 2020

Every WUG Entity with an Identified Need				WMSs REQUIRED TO BE CONSIDERED BY STATUTE												ADDITIONAL					
Water User Group Name	County	Maximum Need 2020-2070 (acf/yr)	Maximum Safe Supply Need 2020-2070 (acf/yr)	Aquifer Storage and Recovery	Conservation	Drought Management	Reuse	Reallocation of Storage	Voluntary Transfers	Conjunctive Use	Expansion of Existing	New Supplies	Regional Water Supply	Improvement of Water Quality	Emergency Transfer of Water	System Optimization, Subordination, and Enhancement	Brush Control	Precipitation Enhancement	Desalination	Cancellation of Water Rights	Interbasin Transfers
WUGs with Needs	Multiple	41,256	47,482	☐	■	☐	■	☐	■	■	■	■	■	■	☐	■	■	☐	■	☐	☐
WUGs with Significant Needs	-	-	-	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Archer City	Archer	20	69	☐	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Archer County MUD 1	Archer	78	106	☐	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Baylor County SUD	Archer	0	0	☐	■	☐	☐	☐	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐
County-Other	Archer	38	65	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Holliday	Archer	64	116	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lakeside City	Archer	0	8	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Scotland	Archer	87	135	☐	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Wichita Valley WSC	Archer	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Windthorst WSC	Archer	83	143	☐	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Irrigation	Archer	757	757	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Livestock	Archer	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Manufacturing	Archer	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Mining	Archer	401	401	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Steam Electric	Archer	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Baylor County SUD	Baylor	0	31	☐	■	☐	☐	☐	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐
County-Other	Baylor	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Seymour	Baylor	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Irrigation	Baylor	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Livestock	Baylor	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Manufacturing	Baylor	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Mining	Baylor	0	0	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Steam Electric	Baylor	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
County-Other	Clay	0	82	☐	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Dean Dale SUD	Clay	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Henrietta	Clay	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Red River Authority	Clay	51	124	☐	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Windthorst WSC	Clay	38	66	☐	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Irrigation	Clay	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Livestock	Clay	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Manufacturing	Clay	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Mining	Clay	0	0	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Steam Electric	Clay	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
County-Other	Cottle	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Paducah	Cottle	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Red River Authority	Cottle	0	0	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Irrigation	Cottle	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Livestock	Cottle	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Manufacturing	Cottle	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Mining	Cottle	0	0	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Steam Electric	Cottle	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
County-Other	Foard	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Crowell	Foard	24	50	☐	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Red River Authority	Foard	0	0	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Irrigation	Foard	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Livestock	Foard	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Manufacturing	Foard	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Mining	Foard	0	0	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Steam Electric	Foard	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
County-Other	Hardeman	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Quanah	Hardeman	76	156	☐	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Red River Authority	Hardeman	72	109	☐	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Irrigation	Hardeman	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Livestock	Hardeman	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Manufacturing	Hardeman	29	126	☐	☐	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Mining	Hardeman	0	0	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Steam Electric	Hardeman	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Every WUG Entity with an Identified Need				WMSs REQUIRED TO BE CONSIDERED BY STATUTE												ADDITIONAL					
Water User Group Name	County	Maximum Need 2020-2070 (acf/yr)	Maximum Safe Supply Need 2020-2070 (acf/yr)	Aquifer Storage and Recovery	Conservation	Drought Management	Reuse	Reallocation of Storage	Voluntary Transfers	Conjunctive Use	Expansion of Existing	New Supplies	Regional Water Supply	Improvement of Water Quality	Emergency Transfer of Water	System Optimization, Subordination, and Enhancement	Brush Control	Precipitation Enhancement	Desalination	Cancellation of Water Rights	Interbasin Transfers
County-Other	King	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Red River Authority	King	0	0	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Irrigation	King	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Livestock	King	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Manufacturing	King	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Mining	King	0	0	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Steam Electric	King	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Bowie	Montague	305	509	☐	■	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
County-Other	Montague	0	34	☐	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Nocona	Montague	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Nocona Hills WSC	Montague	0	12	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Red River Authority	Montague	0	0	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Saint Jo	Montague	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Irrigation	Montague	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Livestock	Montague	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Manufacturing	Montague	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Mining	Montague	1,291	1,291	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Steam Electric	Montague	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Burkburnett	Wichita	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
County-Other	Wichita	0	0	☐	☐	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Dean Dale SUD	Wichita	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Electra	Wichita	395	587	☐	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Harrold WSC	Wichita	6	9	☐	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Iowa Park	Wichita	35	217	☐	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Wichita County WID 2 (Irrigation in Archer, Clay and Wichicita County)	Wichita	30,233	30,233	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	■	☐	■	☐	☐	☐	☐	☐
Sheppard Air Force Base	Wichita	225	408	☐	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Wichita Falls	Wichita	4,333	7,868	☐	■	☐	■	☐	■	■	☐	■	☐	☐	☐	■	☐	☐	☐	☐	☐
Wichita Valley WSC	Wichita	0	0	☐	☐	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Irrigation	Wichita	29,476	29,476	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Livestock	Wichita	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Manufacturing	Wichita	103	513	☐	☐	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Mining	Wichita	0	0	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Steam Electric	Wichita	7	7	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
County-Other	Wilbarger	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Harrold WSC	Wilbarger	43	64	☐	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Red River Authority	Wilbarger	0	5	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Vernon	Wilbarger	26	436	☐	■	☐	☐	☐	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐
Irrigation	Wilbarger	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Livestock	Wilbarger	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Manufacturing	Wilbarger	13	223	☐	☐	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Mining	Wilbarger	0	0	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Steam Electric	Wilbarger	4,706	4,706	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Baylor County SUD	Young	0	0	☐	■	☐	☐	☐	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐
County-Other	Young	0	16	☐	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Olney	Young	56	179	☐	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Irrigation	Young	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Livestock	Young	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Manufacturing	Young	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Mining	Young	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Steam Electric	Young	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

ATTACHMENT 5-3

SUMMARY OF RECOMMENDED STRATEGIES

2021 FINAL PLAN

REGION B

OCTOBER 2020

Entity	County Used	Expected Online Date	Capital Cost	First Decade Unit Cost ($/ac-ft/yr)	Total Yield						Last Decade Unit Cost ($/ac-ft/yr)
					2020	2030	2040	2050	2060	2070	
Alternative Cooling											
Steam Electric Power	Wichita	2020			3	4	5	6	7	10	
Steam Electric Power	Wilbarger	2030	$101,560,000	$0		2,302	2,903	3,504	4,105	4,706	$0
Chloride Control											
Wichita County WID 2	Multiple	2020	$69,430,000	$1,142	5,800	5,220	4,640	4,060	3,480	2,900	$299
Groundwater											
Baylor County SUD	Baylor	2020	$138,000	$355	26	26	25	28	29	31	$32
Vernon	Wilbarger	2020	$1,115,000	$400	600	600	600	600	600	600	$270
Irrigation Conservation											
Wichita County WID 2		2020	$9,713,000	$56	830	2,292	3,656	7,988	10,026	12,850	$56
	Wichita	2020			830	2,292	3,656	7,988	10,026	12,850	
Irrigation	Archer	2020	$0	$9.5	0	6	13	19	25	31	$9.5
Irrigation	Wichita	2020	$0	$9.5	0	196	392	587	783	979	$9.5
Mining Conservation											
Mining	Archer	2020	$1,137,000	$2,800	101	121	86	70	53	53	$2,800
Mining	Baylor	2020	$38,000	$2,800	4	4	3	3	3	3	$2,800
Mining	Clay	2020	$1,852,000	$2,800	153	197	146	118	89	89	$2,800
Mining	Cottle	2020	$94,000	$2,800	10	10	10	9	8	8	$2,800
Mining	Foard	2020	$28,000	$2,800	3	3	3	3	3	3	$2,800
Mining	Hardeman	2020	$47,000	$2,800	4	4	5	5	5	5	$2,800
Mining	King	2020	$893,000	$2,800	95	83	72	63	55	55	$2,800
Mining	Montague	2020	$8,554,000	$2,800	910	644	402	173	194	194	$2,800
Mining	Wichita	2020	$150,000	$2,800	16	15	14	12	11	11	$2,800
Mining	Wilbarger	2020	$47,000	$2,800	5	5	5	5	5	5	$2,800
Mining	Young	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Municipal Conservation											
Archer City	Archer	2020	$0	$438	3	6	9	12	12	12	$407
Archer County MUD	Archer	2020	$0	$368	2	4	5	7	7	7	$403
Holliday	Archer	2020	$0	$338	3	7	10	14	13	13	$395
Lakeside City	Archer	2020	$0	$460	1	2	4	5	6	6	$392
Scotland	Archer	2020	$0	$464	2	6	9	12	12	12	$409
Windthorst WSC	Archer, Clay	2020	$0	$382	5	12	17	22	22	22	$404
County Other	Archer	2020		$483	1	2	4	4	5	5	$415
Baylor County SUD	Baylor	2020	$0	$430	2	5	7	9	11	14	$389
County Other	Clay	2020	$0	$387	7	12	16	22	21	21	$405
Red River Authority	Clay, Cottle, Foard, Hardeman, King, Montague, Wilbarger	2020	$1,430,000	$1,086	0	92	95	98	102	105	$402
Crowell	Foard	2020	$0	$419	1	3	3	4	5	6	$419
Quanah	Hardeman	2020	$0	$396	8	12	20	20	20	20	$394
Bowie	Montague	2020	$0	$404	35	55	55	57	56	56	$401
County Other	Montague	2020	$0	$395	11	25	37	44	63	63	$402
Nocona Hills WSC	Montague	2020	$0	$453	1	2	3	3	5	6	$373
Electra	Wichita	2020	$0	$395	9	17	29	38	47	48	$399
Harrold WSC	Wichita, Wilbarger	2020		$451	1	2	3	4	6	6	$400
Iowa Park	Wichita	2020	$0	$413	11	25	30	41	47	47	$403
Sheppard Air Force Base	Wichita	2020		$387	11	17	29	39	44	44	$401
Wichita Falls	Wichita	2020	$0	$399	169	340	512	686	871	884	$400
Vernon	Wilbarger	2040	$0	$403	0	0	24	49	76	102	$402
Vernon (Pipeline Replacement)	Wilbarger	2050	$8,820,000	$403	0	313	313	313	313	313	$402
County Other	Young	2030	$0	$474	0	1	2	4	4	4	$425
Olney	Young	2050	$0	$400	122	152	142	140	141	145	$399

Entity	County Used	Expected Online Date	Capital Cost	First Decade Unit Cost ($/ac-ft/yr)	Total Yield						Last Decade Unit Cost ($/ac-ft/yr)
					2020	2030	2040	2050	2060	2070	
Reservoir											
Wichita Falls	Wichita	2040	$442,867,000	$1,456	0	0	23,450	23,450	23,450	23,450	$384
Reuse											
Bowie	Montague	2020	$5,123,000	$1,178	550	550	550	550	550	550	$524
Treated Water Line											
Red River Authority	Clay	2030	$3,546,000	$1,657	0	533	533	533	533	533	$1,188
Voluntary Transfer											
Archer County MUD	Archer	2020	$0	$1,140	61	56	83	79	79	78	$1,140
County Other	Archer	2020	$0	$1,140	37	17	31	29	27	27	$1,140
Scotland	Archer	2030	$0	$1,140	0	34	76	73	74	73	$1,140
Windthorst WSC	Archer	2020	$0	$1,140	8	12	93	85	85	84	$1,140
County Other	Clay	2020	$0	$1,140	70	70	70	70	70	70	$1,140
Crowell	Foard	2050	$0	$1,140	0	0	0	22	34	44	$2,344
Quanah	Hardeman	2050	$0	$1,140	0	0	0	59	95	136	$1,141
Red River Authority	Hardeman	2050	$0	$1,140	0	0	0	42	67	93	$1,140
Manufacturing	Hardeman	2020	$0	$1,140	0	52	52	90	107	126	$1,140
County Other	Montague	2020	$0	$1,140	23	7	0	0	0	0	$1,140
Electra	Wichita	2020	$0	$1,629	124	147	315	324	328	333	$1,629
Harrold WSC	Wilbarger	2020	$0	$1,629	36	40	45	49	52	67	$1,629
County Other	Young	2050	$0	$1,140	8	10	12	13	15	16	$1,140
Olney	Young	2050	$0	$815	0	0	0	4	60	150	$815

CHAPTER 6

IMPACTS OF THE REGIONAL WATER PLAN

2021 FINAL PLAN

REGION B

OCTOBER 2020

CHAPTER 6

IMPACTS OF THE REGIONAL WATER PLAN
2021 FINAL PLAN
REGION B

6.1 Requirements

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 chapter is to describe how the 2021 Plan is consistent with the long-term protection of the State's water resources, agricultural resources, and natural resources. The requirement to evaluate the impact of the regional water plan and its consistency with protection of resources is found in 31 TAC Chapter 357.40 & 41, which require the following:

- A description of the socioeconomic impacts of not meeting identified water needs in the region (§357.40(a));
- A description of potential impacts of the regional water plan regarding agricultural resources; other water resources including groundwater and surface water interrelationships; threats to agricultural and natural resources; third-party social and economic impacts resulting from voluntary redistributions of water including moving water from rural and agricultural areas; major impacts of recommended water management strategies on key parameters of water quality; and, effects on navigation (§357.40(b));
- A summary of identified water needs that remain unmet by the plan (§357.40(c));
- A description of how the 2021 Plan is consistent with the long-term protection of the state's water resources, agricultural resources, and natural resources (§357.41); and,
- A summary describing how the 2021 Plan is consistent with the guidelines for water planning as outlined in §357.20 (§357.60(a)).

Following are descriptions of the remaining sections of this Chapter.

- Section 6.2 addresses the socioeconomic impacts of not meeting identified water needs in Region B.

- Section 6.3 addresses impacts of the plan on agricultural resources.
- Section 6.4 addresses impacts of the plan on other water resources.
- Section 6.5 addresses threats to agricultural and natural resources.
- Section 6.6 addresses third-party social and economic impacts resulting from voluntary redistributions of water including moving water from rural and agricultural areas.
- Section 6.7 addresses major impacts of recommended water management strategies on key parameters of water quality.
- Section 6.8 addresses impacts on navigation and impacts on existing water contracts and option agreements.
- Section 6.9 provides a summary of identified water needs that remain unmet by the plan.
- Section 6.10 provides a description of how the 2021 Plan is consistent with the long-term protection of the State's water resources, agricultural resources, and natural resources.
- Section 6.11 provides a description of the plan's consistency with the guidelines for water planning.

6.2. Descriptions of the Socioeconomic Impacts of Not Meeting Identified Needs

The TWDB provided technical assistance to regional planning groups in the development of the potential socioeconomic impacts of failing to meet projected water needs. The TWDB's analysis calculated the impacts of a severe drought occurring in a single year at each decadal period in Region B. 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:

- Without any additional supplies, the projected water needs would reduce the region's projected 2020 employment by 5,200 jobs. This declines to 1,300 lost jobs by 2070. Most of this reduction occurs in the mining sector.

- Without any additional supplies, the projected water needs would reduce the region's projected annual income in 2020 by approximately $1.4 billion. This represents about 16 percent of the region's current income. The loss in income reduces to approximately $339 million in 2070.

The complete socioeconomic study report by the TWDB is included in Appendix E.

6.3 Impacts of the Regional Water Plan on Agricultural Resources

Agriculture which encompasses both farming and ranching is an important economic driver within Region B. With over one million acres in cropland, irrigation is a critical input for sustaining agriculture in the region even when rainfall is normal or above normal, accounting for about 62 percent of all water used. The evaluation of water sources indicates that existing water sources are insufficient to meet irrigation demands in two counties (Archer and Wichita). In the same two counties (Archer and Wichita) water quality may further limit irrigation supplies. For the remaining counties, an average unmet need of 14,392 acre-feet per year remains for the 2020 to 2070 planning period. Unmet irrigation needs account for an average of 95% of the total unmet water needs. The socioeconomic impacts resulting from not meeting these water needs are addressed in Chapter 4.

6.4 Impacts of the Regional Water Plan on Other Water Resources

The water resources in Region B include portions of three river basins providing surface water, and portions of three aquifers providing groundwater. The three river basins present in Region B are the Red River Basin, a small portion of the Trinity River Basin and a small portion of the Brazos River Basin. The respective boundaries of these basins are depicted in Figure 2, in Chapter 1.

Surface water accounts for approximately 58% of the total water supply in the region. Sources within the region include six major reservoirs that are used for water supply and several smaller reservoirs that were previously used for water supply or supply very small amounts of water. Currently, the majority of the available surface water supply used in Region B comes from the Red River Basin with one reservoir in the Trinity River Basin.

The region's groundwater resources include two major aquifers (Seymour and Trinity) and one minor aquifer (Blaine). The extents of these aquifers within the region are depicted in Figures 1-3 and 1-4, in Chapter 1. Groundwater is primarily supplied in Region B by the Seymour and the Blaine. The Seymour is found in the central and western portions of the region. It is currently used in Hardeman, Wilbarger, Wichita, Clay, Baylor, and Foard Counties. The Blaine is considered a minor aquifer and useable groundwater is limited to the westernmost portion of the region. These aquifers provide a large percentage of available supply in these counties. In addition, the upper portion of the Trinity Aquifer occurs in Montague County in the eastern part of the region. Limited quantities of groundwater are used from the Trinity for municipal and irrigation uses.

There are also other formations within the region that are used for groundwater supply in limited areas. The TWDB identifies these sources as "Undifferentiated Other Aquifer". These formations generally are not well defined in the literature, but still provide substantial quantities of water in Archer, Clay, Cottle, King, Montague, Wichita, and Wilbarger Counties.

To be consistent with the long-term protection of water resources, the 2021 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 recommended strategies represent a comprehensive plan for meeting the needs of the region while effectively minimizing threats to water resources. Threats to water resources are minimized in the 2021 Plan in the following ways:

6.4.1 Water Conservation.

Strategies for water conservation have been recommended that will help reduce the demand for water, thereby reducing the impact on the region's groundwater and surface water sources. Advanced water conservation practices are expected to save approximately 2,944 acre-feet of water annually by 2020, reducing impacts on both groundwater and surface water resources. By 2070, the advanced conservation strategies will save a total of 21,974 acre-feet per year. These savings are in addition to the basic water savings assumed in the demands. The plan assumes basic conservation savings in municipal demands due to the implementation of plumbing codes and basic conservation savings in agriculture due to improvements in irrigation efficiency and crop varieties. The total projected water savings from both basic and advanced conservation for Region B by 2070 is 26,790 acre-feet per year. Water conservation benefits the State's water resources by reducing the volumes of withdrawals from water sources that are needed to support human activity.

6.4.2 Water Reuse.

Currently, the majority of reuse in Region B is through the City of Wichita Falls indirect potable water project that delivers 8 million gallons per day (MGD) of treated wastewater to Lake Arrowhead. The City of Wichita Falls also provides 0.25 MGD of cooling water to a plate glass manufacturing facility. The remaining reuse supplies within Region B are limited to municipal irrigation and/or use at the wastewater treatment facilities; however, the City of Bowie has sold nearly all its wastewater effluent for mining purposes in the recent past. Water reuse in general provides a means to more efficiently use the supplies available within the region, conserving the water resources in Region B. Other entities may be looking to develop reuse projects in the near future, but the projects are not anticipated to be online by 2020.

6.4.3 Voluntary Transfers.

This strategy involves the voluntary transfer of water resources from one entity that has a surplus during one or more decades to another entity that has a need. In most cases these transfers are handled directly through implementation of infrastructure that will facilitate a physical transfer of water instead of the transfer or lease of water rights that would constitute a paper transfer without connecting infrastructure. In Region B these voluntary transfers have become a necessary means of addressing water supply to overcome both water supply quantity limitations and water quality limitations. A major benefit of voluntary transfers is reduction of the potential to overuse, overdraft, or otherwise reduce the longevity of existing water resources. In addition, use of voluntary transfers has allowed for reduction of demand from some existing water sources.

6.4.4 Development of New and/or Expanded Use of Surface Water Supplies

Lake Ringgold.

This strategy will increase surface water supplies available for cities, industry, and agriculture in Region B by 23,450 acre-feet per year (firm yield). Lake Ringgold will impact approximately 120 acres of existing ponds and stock tanks and approximately 165 miles of streams. At the conservation elevation of 844 feet, approximately 910 acres of wetlands will be impacted. Lake Ringgold is near the confluence of the Little Wichita River and the Red River Basin. The impoundment should have minimal impact on other water resources or other water management strategies. The WAM, a part of the regional planning process, assesses how the increased use of surface water resources will impact the Region's water resources. The evaluation of Lake Ringgold utilized the current WAM with extended hydrology to ensure that this project did not over allocate State water and respected the water supplies of other water resources.

6.4.5 New and/or Expanded Use of Groundwater.

This strategy includes the construction and development of groundwater supply wells. The recommended strategies for Baylor County SUD and Vernon include additional groundwater development in the Seymour Aquifer.

6.4.6 Brush Control

Brush control is a strategy that is aimed at reducing the amount of water consumed by deep-rooted woody vegetation that has minimal economic or environmental value. This vegetation consumes water from a large area robbing moisture from native grasses and parching the subsoil. The large leaf canopy also intercepts moisture that would otherwise land on the soil. As a result, the brush reduces the potential for runoff and for percolation of moisture into the subsoil that may contribute to aquifer recharge. Brush control removes this vegetation and potentially improves the hydrologic condition of the soil and increases potential for groundwater recharge, especially in water table aquifers like those found in Region B.

6.4.7 Conjunctive Use

Conjunctive use is a strategy that will effectively increase the overall water supply through balancing groundwater demand at critical times with surface water supplies. During times when surface water is plentiful, the groundwater system can recharge or recover. While this strategy may have short term impacts on groundwater during drought conditions, the potential for extended recovery periods offsets the short term impact.

6.4.8 Advanced Treatment

Advanced treatment typically involves removing salts from various marginal or somewhat brackish sources of water. When this process is implemented, the waste stream will contain concentrated salts. It is proposed that these wastes would be discharged in conjunction with existing wastewater discharges. There may be impacts on downstream water resources if the total daily salt load resulting from this strategy is increased over current levels. An alternative would be disposal in an injection well.

6.4.9 Chloride Control Project

The chloride control project is designed to capture water from the chloride seeps that would otherwise flow into the existing surface water sources. While the project structures would capture highly concentrated chloride, water resources would be improved downstream of the capture points. Therefore, this strategy would have little impact on other water resources.

6.5 Threats to Agricultural and Natural Resources

Region B contains many natural resources including threatened or endangered species; local, state, and other public land; and energy/mineral reserves. In addition, excessive concentrations of total dissolved solids, sulfate, and chloride are a general problem in most streams of the Red River Basin under low flow conditions. Following is a brief discussion of how the 2021 Plan may present threats to agricultural and natural resources.

6.5.1 Agricultural Resources

Region B includes over one million acres of cropland and over two million acres of rangeland. Agriculture is an important part of the economy, lifestyle, and history of Region B. Some entire communities were originally built around agricultural products, and lack of water could dramatically change the nature of these communities. When there is insufficient water to grow range grasses and fill stock tanks, there is a high probability that producers will cull or sell entire herds. If herds are not thinned then overgrazing and introduction of noxious grasses, forbes, and woody vegetation will occur.

6.5.2 Natural Resources

As mentioned in Section 6.4.4, construction of Lake Ringgold has the potential to impact natural resources through inundation of 165 miles of streams and 910 acres of wetlands. Many environmental studies will need to be completed in order move forward with this project. Other natural resource impacts may be identified, but as part of the study portion for this project, impacts on natural resources will be evaluated and mitigation designed as needed to offset the impacts.

6.6 Impacts of Moving Water from Agricultural and Rural Areas

The implementation of water management strategies recommended in Chapter 5 of this regional plan is not expected to significantly impact water supplies that are currently in use for agricultural purposes. The voluntary transfer of groundwater from agricultural use to municipal use is predicated on a willing buyer, willing seller basis.

Most of the recommended water management strategies for municipal water users rely on conservation, reuse, voluntary transfers, and the development of Lake Ringgold and the Ogallala Aquifer. Conservation and reuse are protective of existing water supplies, which can delay or eliminate the need for new water. Voluntary transfers rely on existing infrastructure to redistribute water supplies from locations having surplus water to those with anticipated unmet water needs. The development of Lake Ringgold would impact some landowners within the footprint of the reservoir. It is assumed that these landowners would be fairly compensated for their property. When possible, Wichita Falls intends to purchase the lands on a willing buyer and willing seller basis. The Ogallala Aquifer is located within Region A. Thus, the impacts of developing the Ogallala are described in detail in the Region A water plan.

The methodology for assessing the available supply of water for strategies in this regional water plan protects the existing supplies of current users. The plan honors the MAG values adopted for groundwater such that groundwater is protected for current and future use. New surface water supplies were determined using the WAM that protects existing water right holders, including rural and agricultural users.

6.7 Impacts of Recommended Water Management Strategies on Key Water Quality Parameters

This section presents an assessment of the water quality parameters that could be affected by the implementation of water management strategies for Region B. This assessment includes an evaluation of specific water quality parameters that are routinely monitored through the Texas Clean Rivers Program and regulated by the U.S. Clean Water Act. Based on this assessment, the key water quality parameters for each type of strategies are identified. From this determination, the specific water management strategies selected for Region B were evaluated with respect to potential impacts to the key water quality parameters.

6.7.1 Water Conservation

Water conservation is a recommended strategy for irrigation, municipal water and steam electric power use in Region B. Recommended irrigation conservation measures include conversion of canals to pipelines and on-farm conservation. For steam electric power, alternative cooling technologies are recommended. These strategies are not expected to affect water quality adversely. The results should be beneficial because the demand on surface and groundwater resources will be decreased. Municipal conservation should have similar beneficial effects, but at a smaller scale.

6.7.2 Reuse

In general, there are three possible water quality effects associated with the reuse of treated wastewaters:

- There can be a reduction in instream flow if treated wastewaters are not returned to the stream, which could affect TDS, nutrients, and DO concentrations of the receiving stream.
- Conversely, in some cases, reducing the volume of treated wastewater discharged to a stream could have a positive effect and improve levels of TDS, nutrients, DO, and possibly metals in the receiving stream.
- Reusing water multiple times and then discharging it can significantly increase the TDS concentration in the effluent and in the immediate vicinity of the discharge in the receiving stream. Total loading to the stream (i.e. the amount of dissolved material in the waste stream) should not change significantly.

These impacts will vary depending on the quality and quantity of treated wastewater that has historically been discharged to the stream and the existing quality and quantity of the receiving stream.

6.7.3 Voluntary Transfers

Voluntary transfers generally involve the sale of water from one provider to another.
Voluntary transfers of groundwater sources will have minimal impacts on water quality parameters assuming there is no relative change in the amount of groundwater pumped. Impacts on key water quality parameters for large increases in groundwater pumpage to meet contractual sales are discussed in Section 6.7.4 (New and/or Expanded Use of Groundwater Resources).

Pending the location and use of the water under voluntary transfers, changes in locations of return flows (if applicable) could impact flows in receiving streams. Such impacts would be site specific and could be positive or negative, pending the changes.

Generally, these impacts are relative to the quantities of water that are diverted or redistributed. Small quantities are likely to have minimal to no impacts, while large quantities may have measured impacts.

6.7.4 New and/or Expanded Use of Groundwater Resources

The Region B Plan includes a proposal for new groundwater supply wells in the Seymour Aquifer. Increased use of groundwater can decrease instream flows if the base flow is supported by spring flow. Increased use of groundwater has the potential to increase TDS concentrations in area streams if the groundwater sources have higher concentrations of TDS or hardness than local surface water and are discharged as treated effluent. However, this is regulated by the State under its wastewater discharge requirements. Generally, wastewater discharged to a state water course cannot exceed the stream standards of the receiving stream. The water produced from the Seymour Aquifer will be treated using advance treatment (RO) and the discharge of the reject water to the Wichita River may have minimal impact on water quality.

6.7.5 Development of New Surface Water Supplies

Two proposed new surface water projects are included in the Region B Plan. One is the use of Wichita River water which is already permitted but has never been used. The second is the construction of Lake Ringgold. The use of the Wichita River will require the use of advanced treatment (RO) and the discharge back to the Wichita River may have minimal impact on water quality. The construction of Lake Ringgold may include the modification of existing upstream wastewater plants to ensure protection of the water quality in the reservoir.

6.7.6 Brush Control

Brush control is a potentially feasible strategy for the Wichita River upstream of Lake Kemp and the Little Wichita River Watershed upstream of Lake Arrowhead. Impacts to the water quality of area streams will depend upon the methods employed to control the brush. It is assumed that chemical spraying will not be used near water sources. Mechanical removal, prescribed burns and use of the salt cedar beetle are the preferred methods near water sources. With these assumptions, the likelihood of contaminating water sources with chemicals is very low. Increases in stream flow due to reduced evapotranspiration associated with the removed brush should improve water quality in these watersheds.

6.7.7 Conjunctive Use

Conjunctive use is an alternative strategy for Wichita Falls. This strategy would conjunctively use surface water from Wichita Falls sources and groundwater from the Seymour Aquifer. It would allow Wichita Falls the ability to operate their reservoirs in a manner that minimizes impacts to key water quality parameters in the lake while still being able to provide sufficient supplies to its customers from groundwater.

6.7.8 Advanced Treatment

Advanced treatment is recommended for Wichita Falls for the local groundwater and supplies from the Wichita River. The waste stream from the advanced treatment would likely be discharged under its existing permit for discharge to the Wichita River. Under the existing permit, the water quality of the receiving stream is protected. The small amount of proposed discharge is not expected to have impacts to key water quality parameters.

6.7.9 Precipitation Enhancement

Precipitation enhancement is considered as part of the irrigation conservation strategies. These operations are already in progress, so there are no expected changes in water quality associated with this strategy.

6.7.10 Chloride Control Project

The Chloride Control Project is a recommended strategy for WCWID No. 2. The sole purpose of the project is to improve the overall water quality in the Wichita River Basin. This project would have a positive impact on the water quality within the region.

6.8 Impacts on Navigation, Existing Water Contracts, and Option Agreements

In accordance with Section 10 of the Rivers and Harbors Act of 1899, navigable waters are those waters that are subject to the ebb and flow of the tide and/or are presently being used or have been used in the past for use to transport interstate or foreign commerce. In Region B, the major river is the Red River. The Red River is not considered navigable within Region B. Therefore, the Region B Water Plan does not have an impact on navigation.

The Region B Water Plan protects existing water contracts and option agreements by reserving the contracted amount included in those agreements where those amounts were known. In some cases, there were insufficient supplies to meet existing contracts. In those cases, water was reduced proportionately for each contract holder. For entities with shortages, water management strategies were recommended to meet deficits in contractual obligations.

6.9 Summary of Identified Water Needs that Remain Unmet

Table 6-1 summarizes the unmet water needs by water use and county in Region B. The reported numbers represent the remaining quantity of water needed after implementing the recommended strategies described in Chapter 5.

While preliminary calculations also identified unmet municipal needs, these municipal needs were satisfied through water management strategies such as municipal conservation, voluntary transfers, and the development of Lake Ringgold and the Ogallala Aquifer. Accordingly, no unmet municipal water needs are reported in Table 6-1.

Table 6-1
Summary of Unmet Water Needs by Water Use
(in acre-feet per year)

County	Water Use	2020	2030	2040	2050	2060	2070
Archer	Irrigation	470	521	572	623	674	726
Archer	Mining	224	282	179	131	84	84
Montague	Mining	381	0	98	0	0	0
Wichita	Irrigation	14,065	14,744	15,520	13,329	13,431	12,747
Wilbarger	Steam Electric Power	1,701	0	0	0	0	0
Total		16,841	15,547	16,369	14,083	14,189	13,557

6.10 Consistency with Long-term Protection of the State's Water, Agricultural, and Natural Resources

The objective of this section is to address how the selected water management strategies are consistent with protection of water resources, agricultural resources, and natural resources within and beyond the boundaries of the Regional Planning Area.

In developing the Region B Water Plan, the RWPG balanced meeting water shortages with good stewardship of water, agricultural, and natural resources within the region. During the strategy selection process, long-term protection of the State's resources was considered through assessment of environmental impacts, impacts to agricultural and rural areas and impacts to natural resources. The identification and development of strategies considered the maintenance or improvement of the water quality of sources in Region B, which is consistent with the state water quality management plan. Existing in-basin or region supplies were utilized as feasible before recommendations for new water supply projects. The proposed conservation and reuse measures for municipalities, irrigators, mining and steam electric power operators will continue to protect and conserve the State's resources for future water use. Discussion of how the plan addresses threats and impacts to the State's resources within Region B is presented in Sections 6.3 through 6.5. The following sections discuss the consistency with these protections by resource.

6.10.1 Water Resources

The primary water management strategies that may have an impact beyond the boundaries of Region B are those that impact the surface water resources of a stream that flows well beyond the region. For this planning region that is the Red River. Strategies that may produce impacts beyond the limits of the region include:

- **Water reuse.** Potentially reduces downstream flows and may increase water quality concerns downstream.
- **Lake Ringgold.** May also reduce flows in the Little Wichita River downstream of the dam (which is less than 1,000 feet long) and possibly the Red River. This will be mitigated through environmental flow releases.
- **Wichita River Diversion.** May reduce flows in the Wichita River downstream of the diversion; however, the quantity of water proposed for diversion is a small fraction of the total annual flows in the Red River below the confluence with the Wichita River. Also, these diversions are already authorized by the state.
- **Advanced treatment.** May produce a waste that flows downstream and potentially creates water quality concerns.

Potential impacts to surface water-groundwater interactions are minimized due to the lack of defined groundwater aquifers in areas of Region B where there are surface water projects. The Seymour Aquifer, which is a shallow alluvium formation, is known to have connectivity to adjacent surface waters. This interaction is dependent upon specific conditions at the project location. The following projects have the potential to impact the connectivity between surface water and groundwater:

- **Seymour Aquifer Development (Wichita Falls).** This strategy would likely only be used during drought, which could potentially reduce groundwater discharge to the Wichita River. These potential impacts would be temporary as both stream flows and aquifer storage will be recharged during rain events.
- **Wichita River Diversion.** Potential reductions in flows in the Little Wichita River downstream of the dam may reduce groundwater recharge. However, during drought it appears that the local aquifer is recharging the surface water and would help support this project. These potential impacts would be temporary as both stream flows and aquifer storage will be recharged during rain events.

6.10.2 Agricultural Resources

The selected water management strategies are not expected to create concerns for agricultural resources at the statewide level.

6.10.3 Natural Resources

The selected water management strategies are not expected to create concerns for natural resources at the statewide level. However, threatened and endangered species, parks and public lands, and energy/mineral resources are addressed individually below.

Threatened/Endangered Species.

A list of species of special concern, including threatened or endangered species, located within Region B is contained in Table 1-13. Included are ten species of birds, four mammals, two reptiles, one amphibian, two fish, and one mollusk. In general, most WMSs planned for Region B will not affect threatened or endangered species. Development of a new reservoir in the region could affect threatened or endangered species and their habitats. However, the development of any reservoir requires extensive environmental impact studies that address potential effects on threatened or endangered species. Any such impacts indicated by these studies would need to be mitigated in accordance with federal and state environmental regulations in order for the reservoir project to be allowed.

Parks and Public Lands.

The Copper Breaks State Park is located in Hardeman County and the Lake Arrowhead State Park is located in Clay County. In addition, there are numerous local (e.g., city or county parks) recreational facilities, and other local public lands located throughout the region. None of the water management strategies currently proposed for Region B is expected to adversely impact state or local parks or public land.

Energy/Mineral Reserves.

The Texas Railroad Commission reports that Region B has approximately 14,954 regular producing oil wells and 1,283 regular producing gas wells. Table 1-11 provides a tabulation by county of the current oil and gas wells, as of February 2019. These wells are largely in the Barnett Shale. In addition, Georgia-Pacific Corporation operates a gypsum mine in Hardeman County. It is anticipated that the water management strategies will not adversely impact either the oil and gas exploration and production activity within the region or the gypsum mine.

6.11 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 B Water Plan must also be determined to be in compliance with provisions of 31 TAC Chapter 357. The information, data, evaluation, and recommendations included in Chapters 1 through 5 and, Chapters 7 through 11 of the 2021 Plan collectively demonstrate compliance with these regulations. To more clearly demonstrate compliance, Region B has developed a matrix addressing the specific recommendations contained in the referenced regulations. Appendix F contains a completed matrix or checklist highlighting each pertinent paragraph of the regulations. The content of the 2021 Plan has been evaluated against this matrix.

CHAPTER 7

DROUGHT RESPONSE INFORMATION, ACTIVITIES, AND RECOMMENDATIONS

2021 FINAL PLAN

REGION B

OCTOBER 2020

CHAPTER 7

DROUGHT RESPONSE INFORMATION, ACTIVITIES, AND RECOMMENDATIONS
2021 FINAL PLAN
REGION B

7.1 Introduction

Drought response and management have long been important aspects of regional water planning. The extensive drought experienced in Texas during the 2010-2015 timeframe, however, served to re-focus attention on the need for comprehensive consideration of drought management measures. Requirements for improved drought planning in the State through the regional water planning process are found in Title 31 of the Texas Administrative Code (TAC), Part 10, Chapter 357, Subchapter D. Specifically §357.42 of Subchapter D includes requirements related to drought response information, activities, and recommendations. This chapter of the regional plan addresses the requirements found in §357.42.

This chapter also addresses the recommendations of the Drought Preparedness Council (DPC) in a letter dated August 1st, 2019. This Chapter of the Regional Plan generally follows the outline template provided by the TWDB for Chapter 7, satisfying the first recommendation of the DPC. The DPC also recommended that region specific model drought contingency plans be developed for all water use categories in the region that account for more than 10 percent of water demands in any decade. For Region B the water use categories that satisfy this requirement include municipal use and irrigation use. Region B specific model drought contingency plans were developed for municipal use and irrigation use and are discussed in Section 7.7.2.

Region B was significantly impacted by drought during 2010-2015, and although the drought subsided during the late spring and summer of 2015 as major water supply reservoirs were filled, the region can rapidly return to a drought status with seasonal or longer periods of drought occurring frequently.

7.2 Droughts of Record

A central principal of regional water planning is that the availability of water sources is determined for drought-of-record conditions. State-wide, the drought of the 1950's is often considered the drought of record, but on regional or sub-regional bases, other periods of time may actually be demonstrated to have been more severe. Chapter 7 includes a detailed examination of preparations for and responses to drought conditions in the region, as required by §357.42. Such examination begins with identification of significant recent droughts within the region.

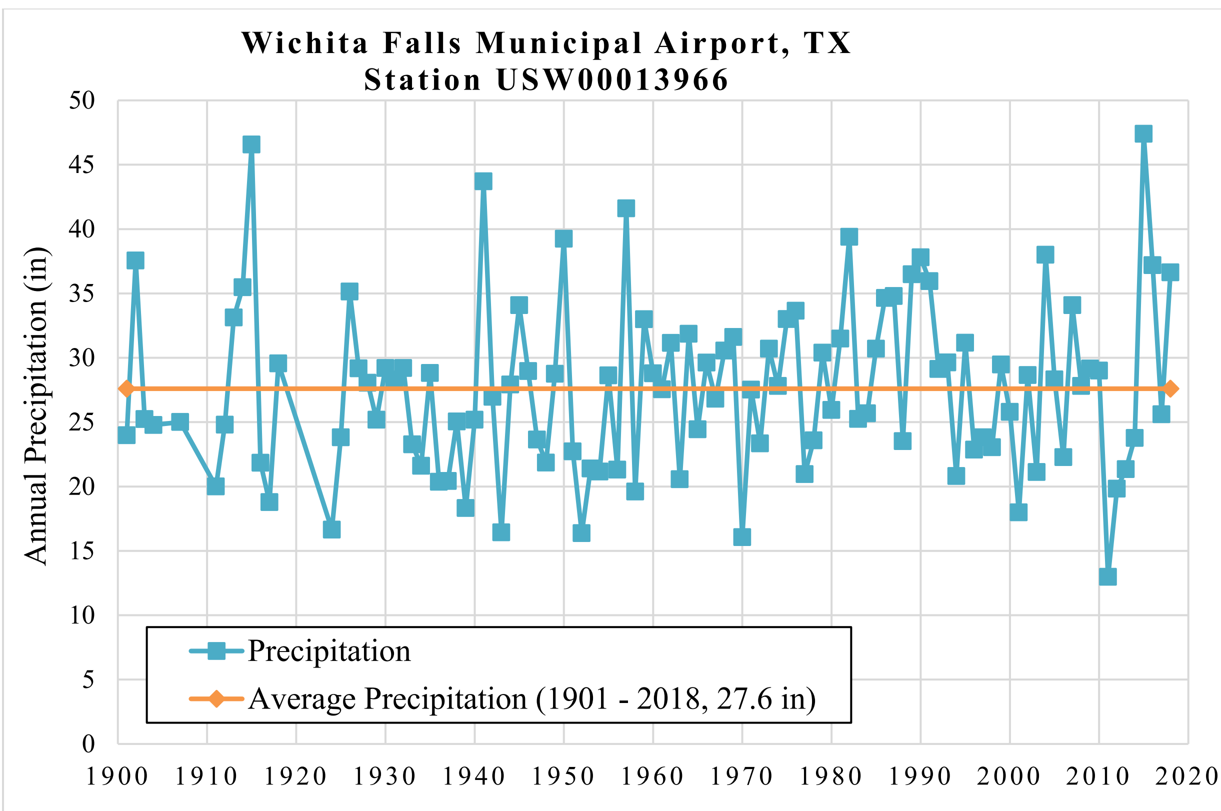
Numerous definitions of drought have been developed to describe drought conditions based on various factors and potential consequences. In the simplest of terms, drought can be defined as "a prolonged period of below-normal rainfall." However, the State Drought Preparedness Plan provides more specific and detailed definitions:

- Meteorological Drought. A period of substantially diminished precipitation duration and/or intensity that persists long enough to produce a significant hydrologic imbalance.
- Agricultural Drought. Inadequate precipitation and/or soil moisture to sustain crop or forage production systems. The water deficit results in serious damage and economic loss to plant and animal agriculture. Agricultural drought usually begins after meteorological drought but before hydrological drought and can also affect livestock and other agricultural operations.
- Hydrological Drought. Refers to deficiencies in surface and subsurface water supplies. It is measured as streamflow, and as lake, reservoir, and groundwater levels. There is usually a lack of rain or snow and less measurable water in streams, lakes, and reservoirs, making hydrological measurements not the earliest indicators of drought.
- Socioeconomic Drought. Occurs when physical water shortages start to affect the health, well-being, and quality of life of the people, or when the drought starts to affect the supply and demand of an economic product.

These definitions are not mutually exclusive and provide valuable insight into the complexity of droughts and their impacts. They also help to identify factors to be considered in the development of appropriate and effective drought preparation and contingency measures.

Regional water planning primarily addresses meteorological, agricultural, and hydrological drought and response to these conditions to avoid socioeconomic drought. Figure 7-1 shows the long-term precipitation for Wichita Falls. This data set shows that the average precipitation in the area is 27.6 inches. The minimum annual rainfall documented during this period was 13.0 inches in 2011. The maximum annual rainfall recorded was 47.4 inches during 2015, which allowed the area to recover from the drought of record (2011) for this sub-region of the state.

Figure 7-1 Precipitation Record for Wichita Falls



Source: https://www.ncdc.noaa.gov/cdo-web/datasets#GSOY, Accessed July 3, 2019.

It can be noted that there were significant periods of low and high rainfall from 1905 to 1930, but this was prior to development of many of the current water supply sources. The minimal rainfall that occurred in 2011 is also less than any annual rainfall total since 1901.

7.2.1 Current Droughts of Record

As described in Chapter 3, the surface water supplies for the regional water plans were determined using the TCEQ-approved Water Availability Models (WAM).[1] For example, the firm yield of a reservoir is the greatest amount of water a reservoir can supply on an annual basis without shortage during a repeat of historical hydrologic conditions, particularly the drought of record. The WAMs incorporate historical hydrologic conditions that occurred between 1940 and 1996; however, data for hydrologic conditions through December 2015 were also used. The droughts of record that were used to evaluate currently available water supplies (Chapter 3) are provided in Table 7-1.

The drought of record can be different for different geographic locations. Based on the current data it appears there have been two primary droughts of record in Region B:

- The drought of the 1950s in the southeastern portion of the region.
- The more recent drought with initiation dates varying from 1993 to 2010 depending upon the location within the remainder of the region.

Table 7-1 Current Droughts of Record for Water Supply Reservoirs

Reservoir Name	Date Last Full (1)	Date of Minimum Content	Drought of Record
Amon Carter (2)	June 1951	March 1957	1951 - 1957
Arrowhead	May 2010	February 2015	2010 - 2015
Kemp	November 2010	March 2015	2010 - 2016
Kickapoo	May 2010	June 2014	2010 - 2015
Olney/Cooper	June 1993	April 2015	1993 - 2015
Nocona	March 2001	February 2015	2001 - 2015

(1) The Date Last Full is based on the safe yield analyses. (Note: Safe yield analyses assume the reservoir is full at the beginning of the simulation.)

(2) Hydrology for Amon Carter is based on the Trinity WAM period of record and was not extended.

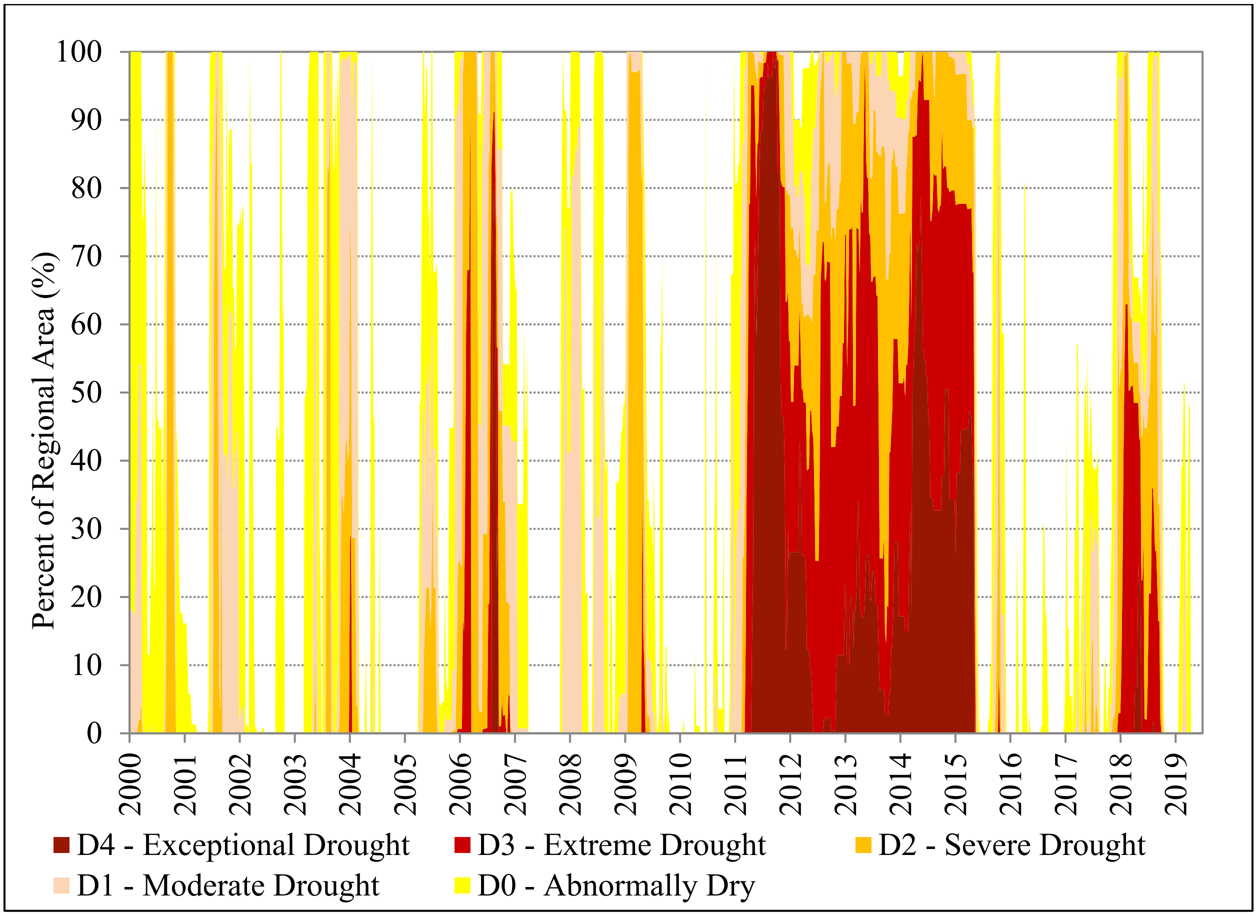
7.2.2 Recent Droughts in the Region

There are many ways to measure drought, including the U.S. Drought Monitor index, the Palmer Hydrological Drought Index, and reservoir water levels. These three indicators were reviewed to identify significant droughts in Region B since the mid-1990's.

The Drought Monitor is a composite index that is calculated weekly based on measurements of climatic, hydrologic, and soil conditions, as well as reported impacts and observations from more than 350 contributors around the country.[2] The Drought Monitor was initiated in 2000, and data can be obtained for each county in the United States. Figure 7-2 shows a composite Drought Monitor index calculated for the counties in Region B over the period of record. This composite index shows the percentage of the land area in the affected counties that experienced different levels of drought. The Drought Monitor index indicates that about 50 percent of region has continued with Extreme Drought or Exceptional Drought conditions from early 2011 through the start of 2015. Over 95 percent of the region experienced Exceptional Drought conditions from late July through early October 2011 with about 25 percent of the region being in extreme or exceptional drought continuously from July 2011 through May 2015.

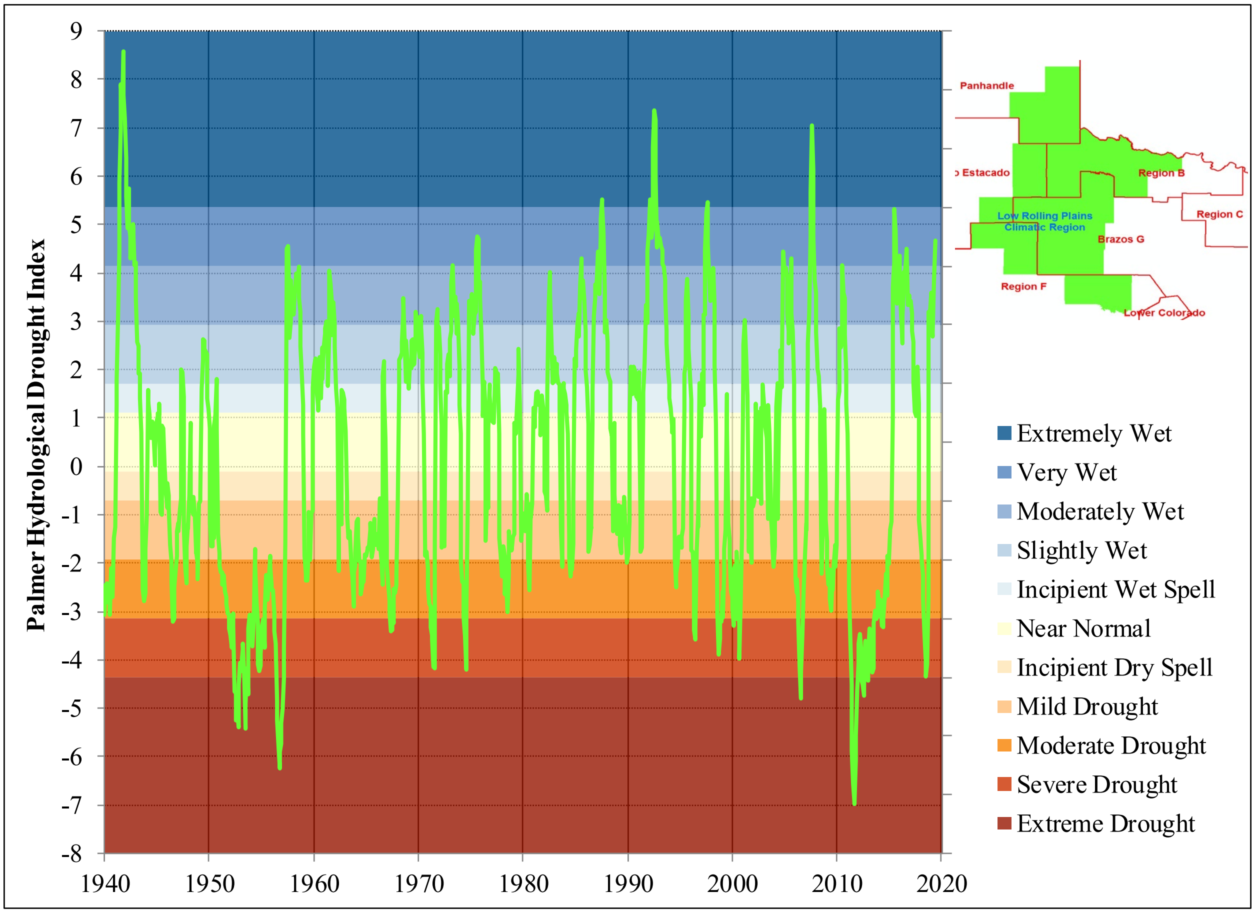
Compared to climatic effects of drought, the hydrological effects, such as lower reservoir and groundwater levels, may take longer to develop and longer still for recovery. The Palmer Hydrological Drought Index (PHDI) was developed as an indicator of the long-term cumulative moisture supply. The PHDI is available on a monthly basis for each year since 1900 for ten climatic regions in each state.[3] The Low Rolling Plains climatic region includes the western half of Region B and the North Central climatic region includes the eastern half of Region B. Figure 7-3 shows the PHDI for the Low Rolling Plains and Figure 7-4 shows the PHDI for the North Central climatic region.

Figure 7-2 Composite Drought Monitor Index for Counties in Region B



Source: https://droughtmonitor.unl.edu/Data/DataDownload/ComprehensiveStatistics.aspx, July 2019.

Figure 7-3 Palmer Hydrological Drought Index for the Low Rolling Plains Climatic Region

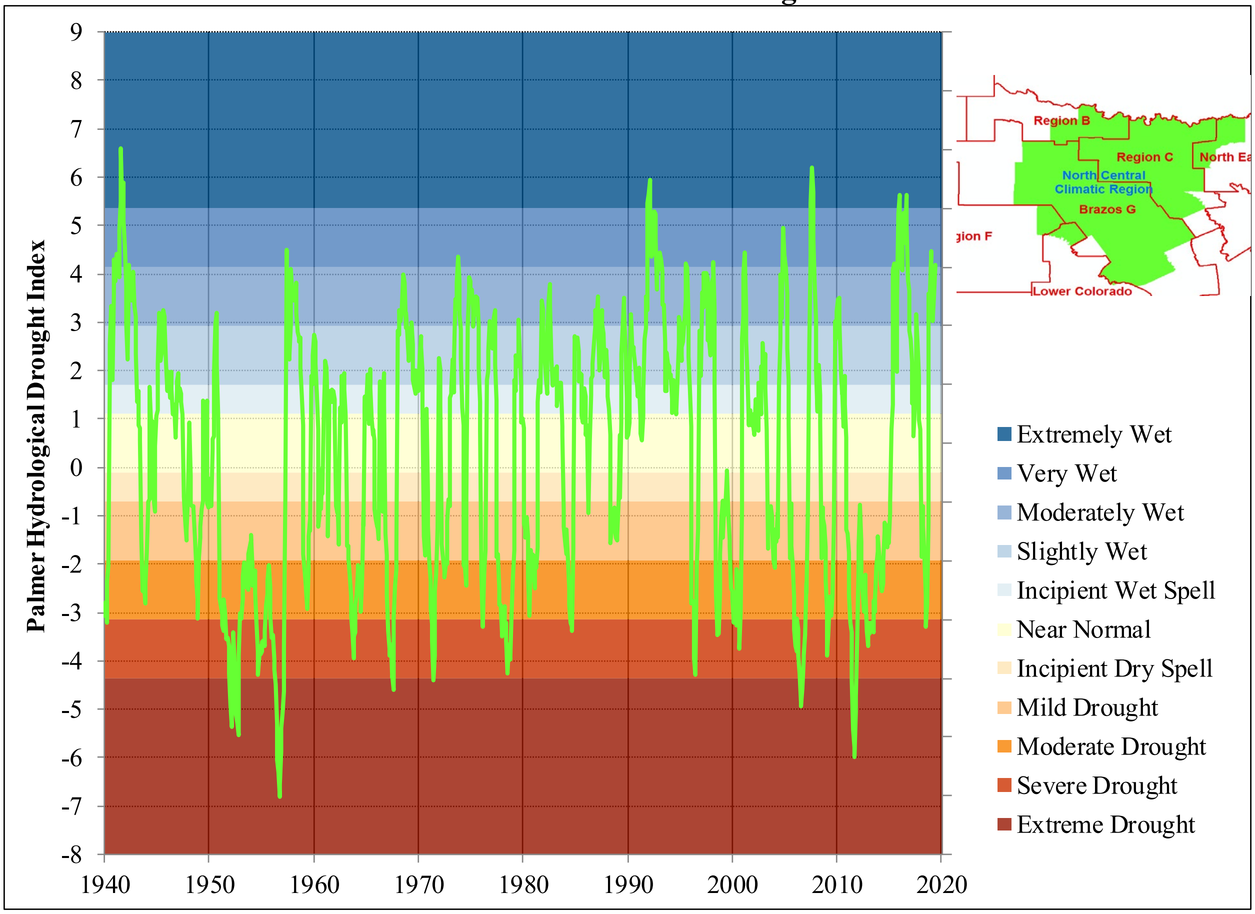


Source: Source: National Climatic Data Center: PHDI Divisional Data,

URL: Source: ftp://ftp.ncdc.noaa.gov/pub/data/cirs/climdiv/climdiv-phdidv-v1.0.0-20190604, July 2019.

The PHDI reflects extended droughts during the 1950s and 2010-2015 with many shorter-term droughts occurring during the period of record. According to the PHDI, the peak (lowest downward spike) of the 2010-2015 drought was slightly more severe in the Low Rolling Plains region and slightly less severe in the North Central region. The peak of the drought in the 1950s was slightly more significant in the North Central region as compared with the Low Rolling Plains.

Figure 7-4 Palmer Hydrological Drought Index for the North Central Climatic Region



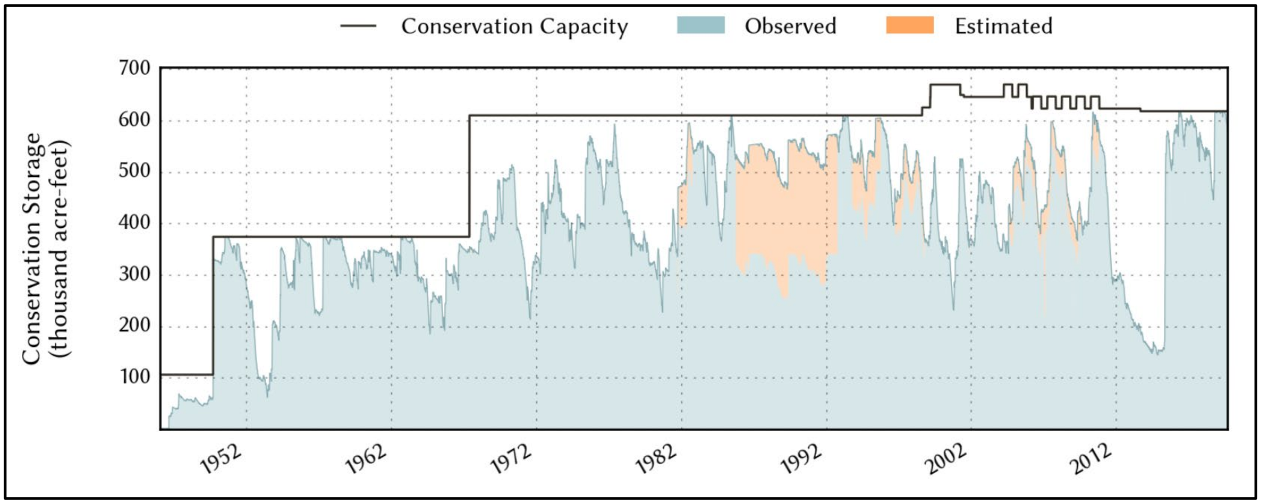
Source**:** Source: National Climatic Data Center: PHDI Divisional Data,

URL: Source: ftp://ftp.ncdc.noaa.gov/pub/data/cirs/climdiv/climdiv-phdidv-v1.0.0-20190604, July 2019.

Another means of considering the drought is the impact on specific water sources. The total reservoir storage in Region B over the period of record is presented in Figure 7-5.[4] This figure indicates that the total conservation storage available within the region has increased as the result of constructing additional reservoirs. However, the available water supply dropped to about 150,000 acre-feet during the recent drought (2010-2015). During the drought of the 1950s, less than 100,000 acre-feet remained in storage, but with much less total available reservoir storage capacity.

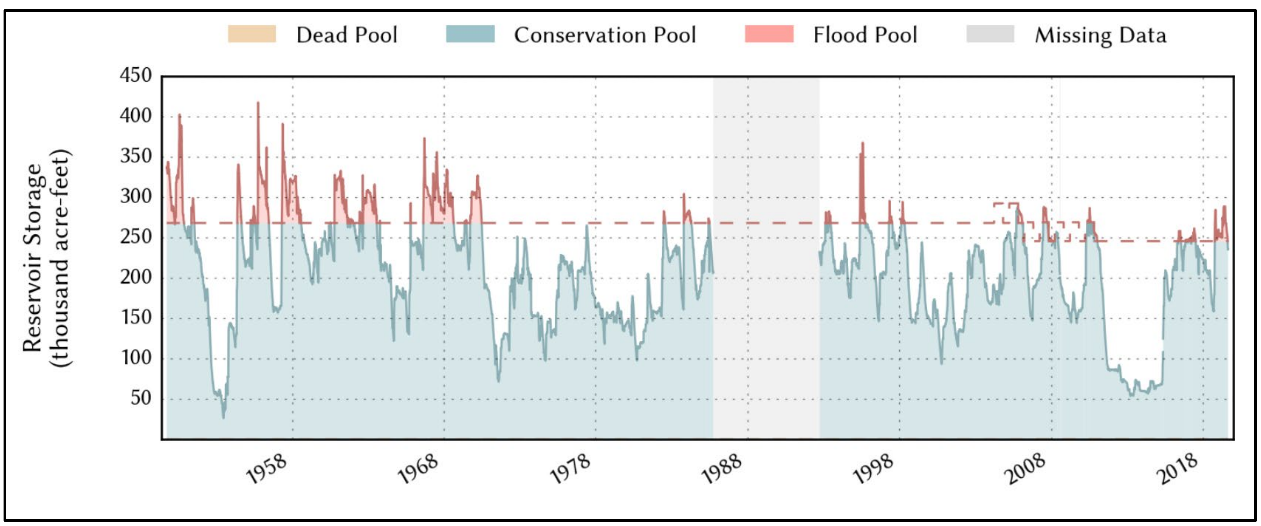
Figure 7-6 provides the reservoir storage volume for Lake Kemp, which is one of the oldest and largest reservoirs serving Region B. Since about 1970, the reservoir has seldom been filled above the conservation pool level. The recent drought (2010-2015) caused a significant prolonged reduction in available water supply stored in Lake Kemp.

Figure 7-5 Composite Reservoir Storage in Region B



Source: Texas Water Development Board: Region B Planning Region Reservoirs, URL: http://waterdatafortexas.org/reservoirs/region/region-b, accessed July 2019.

Figure 7-6: Reservoir Storage in Lake Kemp



Source: Texas Water Development Board: Region B Planning Region Reservoirs, URL: http://waterdatafortexas.org/reservoirs/individual/kemp, accessed January 2015.

All drought indicators discussed in this section support a determination that the 2010-2015 period is the most significant drought, and establishes the new drought of record for Region B.

7.3 Summary of Current Drought Triggers.

The majority of the drought contingency plans in Region B use trigger conditions based on the state of water supply sources. For surface water sources the drought triggers are specific reservoir levels or volumes. For groundwater sources, the drought triggers are based on groundwater production capacity. Drought triggers for each of the surface water sources and information regarding the managing entity for each source follows. Where appropriate, the RWPG recommended retaining the triggers by stage currently in place in drought contingency plans adopted by entities responsible for managing the water source.

7.3.1 Lake Kickapoo and Lake Arrowhead

The City of Wichita Falls operates Lake Kickapoo and Lake Arrowhead. The following describes the existing drought stages triggers in these lakes under the City's DCP:

- Stage 1 – "Drought Watch" combined storage reaches 65% of conservation capacity.
- Stage 2 – "Drought Warning" combined storage reaches 50% of conservation capacity.
- Stage 3 – Drought Emergency" combined storage reaches 40% of conservation capacity.
- Stage 4 – "Drought Disaster" combined storage reaches 30% of conservation capacity.
- Stage 5 – "Drought Catastrophe" combined storage reaches 25% of conservation capacity.

7.3.2 Lake Kemp

The Wichita County Water Improvement District No. 2 operates Lake Kemp. The following describes the existing drought stages triggers for this lake under the District's DCP:

- Stage 1 – Voluntary Water Conservation - Lake elevation above 1,138 ft msl (70%)
- Stage 2 – Severe – Lake elevation between 1137.5 ft and 1131.55 ft (50%)
- Stage 3 – Critical – Lake elevation between 1131 ft and 1123.5 ft (31%)

- Stage 4 – Emergency – Lake elevation between 1123 ft and 1109.55 ft (10%)
- Stage 5 – City of Wichita Falls – Lake elevation drops below 1109 ft (9.5%)

7.3.3 Petrolia City Lake

The City of Petrolia operates Petrolia City Lake. The following describes the existing drought stages triggers for this lake under the City's DCP:

- Stage 1 – Lake storage drops below 60% capacity
- Stage 2 – Lake storage drops below 50% capacity
- Stage 3 – Lake storage drops below 35% capacity

7.3.4 Lakes Olney and Cooper

The City of Olney operates Lakes Olney and Cooper which are adjoining reservoirs. The following describes the existing drought stages triggers for Lake Cooper under the City's DCP:

- Stage 1 – Lake elevation drops below 1,135 ft msl
- Stage 2 – Lake elevation drops below 1,133 ft msl
- Stage 3 – Lake elevation drops below 1,130 ft msl
- Stage 4 – Lake elevation drops below 1,127 ft msl

7.3.6 North Fork Buffalo Creek Lake

The City of Iowa Park operates North Fork Buffalo Creek Lake. The lake is no longer used for municipal water supply and there are no longer trigger conditions identified for this reservoir. The City of Iowa Park has adopted a DCP that follows the DCP triggers for Wichita Falls.

7.3.7 Lake Electra

The City of Electra operates Lake Electra. The lake is no longer used for municipal water supply and there are no longer trigger conditions identified for this reservoir. The City of Electra has adopted a DCP that follows the DCP triggers for Wichita Falls.

7.3.8 Lake Amon G. Carter

The City of Bowie operates Lake Amon G. Carter. The following describes the existing drought stages triggers in this lake under the City's DCP:

- Stage 1 – Lake elevation drops below 917 feet msl
- Stage 2 – Lake elevation drops below 913 feet msl
- Stage 3 – Lake elevation drops below 909 feet msl
- Stage 4 – Lake elevation drops below 905 feet msl.
- Stage 5 – Emergency, major water production or distribution limitations.

7.3.9 Greenbelt Reservoir

The Greenbelt Municipal and Industrial Water Authority (GMIWA) operates Greenbelt Reservoir, which is located in Region A. Several of the water suppliers in Region B obtain water from Greenbelt Reservoir and have adopted DCPs based on the GMIWA DCP. The following describes the existing drought stages triggers under the GMIWA's DCP:

- Stage 1 – Mild water shortage, lake elevation reaches 2,634.0 ft msl
- Stage 2 – Moderate water shortage, lake elevation drops below 2,631.0 ft msl
- Stage 3 – Severe water shortage, lake elevation drops below 2,628.0 ft msl
- Stage 4 – Emergency water shortage, lake elevation drops below 2,625.0 ft msl

7.3.10 Groundwater Sources

Drought contingency plans are addressed for the following groundwater conservation districts:

- Gateway Groundwater Conservation District
- Rolling Plains Groundwater Conservation District
- Upper Trinity Groundwater Conservation District

Gateway Groundwater Conservation District

The Gateway Groundwater Conservation District has adopted rules that indicate the district will provide drought severity information to all groundwater users in the district. The Palmer Drought severity index value will updated on the District's web site on a bi-monthly basis.

Rolling Plains Groundwater Conservation District

The Rolling Plains Groundwater conservation District primarily serves an agricultural area and has adopted a philosophy that water conservation is a continuous operating principle, and that all agricultural producers are to make every effort to conserve groundwater. Due to the significant impact that drought can have on agricultural producers, the district has adopted an operating policy that it will not limit groundwater use during drought periods beyond the limits provided by district rules.

Upper Trinity Groundwater Conservation District

The Upper Trinity Groundwater Conservation District has adopted the objective of performing a monthly review of drought conditions as posted by the TWDB on the Board's web site. In addition, the District will complete an annual review of drought conditions within the district and include this information in the Annual Report to the Board of Directors and will post the information on the District's web site.

7.4 Current Drought Preparations and Response

In 1997, the Texas Legislature directed the TCEQ to adopt rules establishing common drought plan requirements for water suppliers in response to drought conditions throughout the state. Since 1997, the TCEQ has required all wholesale public water suppliers (TAC §288.30.6), retail public water suppliers serving 3,300 connections or more (TAC §288.30.5.A), and irrigation districts (TAC §288.30.7) to submit drought contingency plans.[5] All drought contingency plans should be updated every five years and be available for inspection upon request. The most recent updates were to be submitted to the TCEQ by May 1, 2019.

All wholesale water providers and larger retail municipalities in Region B have taken steps to prepare for and respond to drought through the preparation of individual Drought Contingency Plans and by taking the necessary steps to implement the Drought Contingency Plans. The plans are required to specify quantifiable targets for water use reductions for each stage, and a means and method for enforcement.

7.4.1 Entities Required to Have DCPs.

Table 7-2 is a list of all entities required to have DCPs, indicates which water suppliers are required to submit the DCP to Region B, and which suppliers have voluntarily provided a copy of the DCP to the Region B.

Table 7-2 Region B Water Suppliers Required to Maintain Drought Contingency Plans

Regulated Entity	County	Required to Submit DCP to Region B	DCP Submitted to Region B
Amon G Carter Lake WSC	Montague		
Archer County MUD 1	Archer		
Baylor SUD	Baylor		
Bluegrove WSC	Clay		
Charlie WSC	Clay		
City of Archer City	Archer	Yes	Yes
City of Bellevue	Clay		
City of Bowie	Montague	Yes	Yes
City of Burkburnett	Wichita	Yes	Yes
City of Byers	Clay	Yes	Yes
City of Chillicothe	Hardeman		
City of Crowell	Foard		
City of Electra	Wichita	Yes	Yes
City of Henrietta	Clay	No	Yes
City of Holliday	Archer		
City of Iowa Park	Wichita	Yes	Yes
City of Lakeside City	Archer		
City of Megargel	Archer		
City of Nocona	Montague	No	Yes
City of Olney	Young		
City of Paducah	Cottle		
City of Petrolia	Clay		
City of Quanah	Hardeman		
City of Saint Jo	Montague		
City of Scotland	Archer		
City of Seymour	Baylor	Yes	Yes
City of Vernon	Wilbarger	Yes	Yes
City of Wichita Falls	Wichita	Yes	Yes
Dean Dale SUD	Clay	Yes	Yes
Forestburg WSC	Montague		
Friberg-Cooper WSC	Wichita		
Gateway GWCD	Hardeman		
Greenbelt Municipal & Industrial Water Authority	Montague	Yes	Yes
Harrold WSC	Wilbarger		
Horseshoe Bend Estates	Wichita		
King Cottle WSC	Cottle		
Montague Water System	Montague		
Nocona Hills WSC	Montague		
North Montague County WSD[1]	Montague	Yes	Yes

Regulated Entity	County	Required to Submit DCP to Region B	DCP Submitted to Region B
Northside WSC	Wilbarger		
Oak Shores Water System	Montague		
Oklaunion WSC	Wilbarger		
Red River Authority of Texas	Multiple	Yes	Yes
RRA Arrowhead Lake Lots	Clay		
RRA Box Community Water System	Wilbarger		
RRA Farmers Valley Water System	Wilbarger		
RRA Foard County Water System	Foard		
RRA Goodlett Water System	Hardeman		
RRA Guthrie Dumont Water System	King		
RRA Hinds Wildcat Water System	Wilbarger		
RRA Lockett Water System	Wilbarger		
RRA Medicine Mound Water System	Hardeman		
RRA New Goodlett Water System	Hardeman		
RRA Northeast Quanah Water System	Hardeman		
RRA Ringgold	Montague		
RRA Southwest Quanah Water System	Hardeman		
Rolling Plains GCD	Baylor		
Sheppard Air Force Base	Wichita		
Sunset Water System	Montague		
Thalia WSC	Foard		
Town Of Pleasant Valley	Wichita		
Upper Trinity GCD	Montague		
Wichita County WID#2	Wichita	Yes	Yes
Waterco	Montague		
Wichita Valley WSC	Wichita		
Windthorst WSC	Archer		

1. The State Legislature is dissolving this district by the end of 2019. The City of Nacona will take over their responsibilities in 2020.

7.4.2 Water Use Reduction Targets

Stage 1 water use reduction targets range from 5 to 20 percent of total water use. Water use reduction targets in the final stage range from 30 to 60 percent of total water use. In some cases the final stage includes water rationing or reduction to a specific water production limit, which results in even greater water savings. Some WUGs do not list a reduction target for the final stage, but these plans indicate that water use limits will be based on the available supply. Table 7-3 includes a summary of the basis for drought triggers, the drought triggers for each stage and the conservation goals for each stage included in the DCPs for entities in Region B that have provided copies to the RWPG. This table also indicates the first stage where mandatory measures are required.

Table 7-3: Drought Trigger Conditions and Goals Documented in Drought Contingency Plans

Entity	**Trigger Based On:**		**First Stage with Mandatory Measures**	**Drought Stage Triggers by Stage** (S. = Supply; D. = Demand)					
				Percent Reduction Goal					
	Supply	**Demand**		**Stage 1**	**Stage 2**	**Stage 3**	**Stage 4**	**Stage 5**	**Stage 6**
City of Archer City	Arrowhead & Kickapoo	Demand	1	S. <= 60% D. >= 105%	S <= 50% D. >= 110%	S. <= 40% D. >= 115%	S. <= 30% D. >= 120%	S. <= 25% D. >= 120%	-
				N/A	*Surcharge*	*Surcharge*	*Surcharge*	*Surcharge*	-
City of Bowie	Lake Amon G. Carter	Demand	2	S. <= 917 ft D. >= 85%	S. <= 913 ft D. >= 90%	S. <= 909 ft D. >= 100%	S. <= 905 ft D. >= 110%	Source Contamination	-
				5%	*15%*	*25%*	*35%*	*As Needed*	-
City of Burkburnett	Notice from Wichita Falls	Total Demand	2	May 1-Sept 30 Annually	D. >= 21 MG for 10 days	D. >= 24 MG for 10 days	D. >= 27 MG for 10 days	D. >= 30 MG for 10 days	Public Health Threat
				5%	*15%*	*35%*	*45%*	*50%*	*Rationing*
City of Crowell		Water Distribu-tion Capacity	2	D. >= 85% for 2 days	D. >= 95% for 2 days	D. = 100% of capacity	-	-	-
				5%	*25%*	*25%*			
City of Electra	Arrowhead & Kickapoo	Demand	1	S. <= 65% D. >= 90%	S. <= 50% D. >= 90%	S. <= 40% D. >= 90%	S. <= 30% D. >= 100%	S. <= 25%	-
				5%	*15%*	*35%*	*45%*	*55%*	
City of Henrietta	Arrowhead Volume	Demand	2	S. <= 60% D. >=1.2 MGD	S. <= 50% D. >=1.3 MGD	S. <= 40% D.>=1.35MGD	S. <= 30% and D.>=1.38MGD	S. <= 25%	-
				-	-	-	-	-	
City of Iowa Park	Notice from Wichita Falls (WF)	Demand	2	WF @ Stg 1 or D.>= 90% for 3 days	WF @ Stg 2 or D.>= 90% for 3 days	WF @ Stg 3 or D.>= 90% for 3 days	WF @ Stg 4 or D.>= 100%	WF @ Stg 5	-
				5%	*15%*	*35%*	*45%*	*55%*	
City of Nocona	Lake Nocona Levels	Treatment Capacity	2	May1 to Sep30 Annually	Lake 824 ft or D: >=85%	Lake 822 ft or D: >=70%	Lake 819 ft or D: >=50%	Lake 817 ft or D: >=40%	As Needed
				30%	*15%*	*30%*	*50%*	*60%*	*As Needed*
City of Olney	Lake Cooper	-	1	S. <= 1135 ft	S. <= 1133 ft	S. <= 1130 ft	S. <= 1127 ft	-	-
				Use Limits	*Use Limits*	*Use Limits*	*Use Limits*	-	-
City of Seymour	Seymour Water Storage Tank	-	2	S. <= 80%	Water Table <= 9 feet	Water Table <= 6 feet	Failures or Contamination	-	-
				10%	*10%*	*20%*	*Cease Wtr Sys.*		

Entity	**Trigger Based On:**		**First Stage with Mandatory Measures**	**Drought Stage Triggers by Stage** (S. = Supply; D. = Demand) *Percent Reduction Goal*					
	Supply	**Demand**		**Stage 1**	**Stage 2**	**Stage 3**	**Stage 4**	**Stage 5**	**Stage 6**
City of Vernon	Seymour Aquifer	-	3	S. <= 41ft or 15% loss of prod. capacity	S. <= 38.5ft or 20% loss of prod. capacity	S. <= 37.5ft or 25% loss of prod. capacity	S. <= 36ft or 30% loss of prod. capacity	S. <= 34ft or 50% loss of prod. capacity	-
				15%	*20%*	*25%*	*30%*	*50%*	-
City of Wichita Falls	Arrowhead & Kickapoo	-	1	S: <= 65%	S: <= 50%	S: <= 40%	S: <= 30%	S: <= 25%	-
				5%	*15%*	*35%*	*45%*	*14 MGD limit*	-
Dean Dale SUD	Arrowhead & Kickapoo	-	2	S: <= 60%	S: <= 50%	S: <= 40%	S: <= 30%	-	-
				5%	*15%*	*20%*	*30%*	-	
North Montague County Water Supply District	Lake Nocona	Total Demand	3	May1 to Sep30 Annually	S. <= 824 ft. D. >= 0.66 mgd	S. <= 822 ft. D. >= 0.88 mgd	S. <= 819 ft. D. >= 1.1 mgd	S. <= 817 ft. Major Interrupt	S. <= 815 ft. Major Interrupt
				30% of Peak	*15%*	*30%*	*50%*	*Alt. Wtr. Src.*	*Ration*
RRA Dodson Water System	GW Capacity	-	3	20% loss in prod. capacity	36% loss in prod. capacity	49% loss in prod. capacity	59% loss in prod. capacity	-	-
				20%	*30%*	*40%*	*As Needed*	-	-
RRA Farmers Valley Water System	GW Capacity	-	3	20% loss in prod. capacity	36% loss in prod. capacity	49% loss in prod. capacity	59% loss in prod. capacity	-	-
				20%	*30%*	*40%*	*As Needed*	-	-
RRA Guthrie Dumont Water System	GW Capacity	-	3	20% loss in prod. capacity	36% loss in prod. capacity	49% loss in prod. capacity	59% loss in prod. capacity	-	-
				20%	*30%*	*40%*	*As Needed*	-	-
RRA Howardwick Water System	GW Capacity	-	3	20% loss in prod. capacity	36% loss in prod. capacity	49% loss in prod. capacity	59% loss in prod. capacity	-	-
				20%	*30%*	*40%*	*As Needed*	-	-
RRA Preston and Lake Arrowhead Water Systems	GW Capacity	-	3	20% loss in prod. capacity	36% loss in prod. capacity	49% loss in prod. capacity	59% loss in prod. capacity	-	-
				20%	*30%*	*40%*	*As Needed*	-	-
RRA Ringgold WSC	GW Capacity	-	3	20% loss in prod. capacity	36% loss in prod. capacity	49% loss in prod. capacity	59% loss in prod. capacity	-	-
				20%	*30%*	*40%*	*As Needed*	-	-
RRA Samnorwood Water System	GW Capacity	-	3	20% loss in prod. capacity	36% loss in prod. capacity	49% loss in prod. capacity	59% loss in prod. capacity	-	-
				20%	*30%*	*40%*	*As Needed*	-	-
RRA Truscott-Gilliland Water System	GW Capacity	-	3	20% loss in prod. capacity	36% loss in prod. capacity	49% loss in prod. capacity	59% loss in prod. capacity	-	-
				20%	*30%*	*40%*	*As Needed*	-	-

Drought response measures vary somewhat across drought contingency plans. In general, retail water suppliers have a wider range of drought response measures available to them compared to wholesale water suppliers. One of the main drought response measures for retail water suppliers is restricting irrigation. Many plans include the following progression of irrigation limits:

- Stage 1: Voluntary limits on irrigation days (maximum of twice per week, odd/even schedule, etc.) and hours (no irrigation in the middle of the day).
- Stage 2: Mandatory limits on irrigation days and hours with irrigation limited to two days per week
- Stage 3: Irrigation limited to one day per week. Hand-held hoses may be used.
- Stage 4: Hand-held hoses or watering cans only may be used on the designated day and within the allowable hours.
- Stage 5: No outdoor water use.

The majority of Region B was in some stage of drought status from late 2010 until May of 2015. Wichita Falls and most of the other water suppliers in Region B moved to Stage 5 or the highest stage of the DCPs in May 2014. The utilities and customers operated in Stage 5 for approximately one full year with no outdoor watering from the public water supplies allowed. The region experienced relief from the drought in May 2015, lasting through the end of 2017. Drought conditions reappeared for a short term in the first half of 2018.

7.4.3 Unnecessary or Counterproductive Variation in Drought Response Strategies

In reviewing the drought response strategies presented in Table 7-3 there are some inconsistencies between drought triggers and the number of stages in drought contingency plans. There are generally drought contingency plans that have adopted five stages of drought that are consistent with the City of Wichita Falls drought trigger conditions and drought reduction goals for each drought stage. This allows for consistency in providing information to the public within the vicinity of Wichita Falls. The groundwater systems have generally adopted 4-stages of drought conditions consistent with the goals in the Red River Authority Drought Contingency Plans for groundwater supplies. There are a limited number of plans that depart from these two general types of drought contingency plans, having a different number of drought stages, drought triggers, and reduction targets.

Region B has identified that having variation between the number of drought stages, trigger conditions, and water use reduction targets can create some uncertainty for users in the event of a drought if the messages communicated in the region do not match the local drought contingency plan requirements. All WUGs in Region B should consider the "Region-Specific Drought Response Recommendations and Model Drought Contingency Plans" identified in Section 7.7 of this Chapter.

7.5 Existing and Potential Emergency Interconnects

According to Texas Statute §357.42(d),(e) regional water planning groups are to collect information on existing major water infrastructure facilities that may be used in the event of an emergency shortage of water. Pertinent information includes identifying the potential user(s) of the interconnect, the potential supplier(s), the estimated potential volume of supply that could be provided, and a general description of the facility. Texas Water Code §16.053(c) requires information regarding facility locations to remain confidential.

This section provides general information regarding existing and potential emergency interconnects among water user groups within Region B.

7.5.1 Existing Emergency Interconnects

Much of Region B has dealt with drought conditions repeatedly over the last 20 years. As a result many of the local supplies derived from smaller reservoirs or from groundwater systems have been limited. In addition water quality has limited use of some supplies. Therefore, interconnects between water systems have become routine with many of the systems now relying on supplies from neighboring systems. In fact, the drought between 2011 and 2015 required implementation of almost all feasible interconnects. The existing interconnects are shown in Table 7-4.

Table 7-4 Existing Interconnects Between Region B WUGs

Receiver Public Water System	Provider WUG
Amon G Carter Lake WSC	City of Bowie
Archer County MUD 1	City of Wichita Falls
Baylor WSC	City of Seymour
Charlie WSC	City of Byers, Dean Dale WSC, City of Wichita Falls
City Of Burkburnett	City of Wichita Falls
City Of Byers	Dean Dale WSC City of Wichita Falls
City Of Chillicothe	Greenbelt MIWA
City Of Crowell	Greenbelt MIWA
City Of Electra	City of Iowa Park City of Wichita Falls
City Of Holliday	City of Wichita Falls
City Of Iowa Park	City of Wichita Falls
City Of Lakeside City	City of Wichita Falls
City of Megargel	Baylor WSC City of Seymour
City Of Quanah	Greenbelt MIWA
City Of Scotland	City of Wichita Falls
City Of Seymour	Baylor WSC
Dean Dale SUD	City of Wichita Falls
Friberg Cooper WSC	City of Wichita Falls
Harrold WSC	City of Electra City of Iowa Park City of Wichita Falls
Horseshoe Bend Estates	City of Wichita Falls
Northside WSC	City of Vernon
Oklaunion WSC	City of Vernon
RRA Lockett Water System	City of Vernon
RRA Box Community Water System	City of Vernon
RRA Farmers Valley Water System	Greenbelt MIWA
RRA Foard County Water System	Greenbelt MIWA
RRA Goodlett Water System	Greenbelt MIWA
RRA Hinds Wildcat Water System	City of Vernon
RRA Medicine Mound Water System	Greenbelt MIWA
RRA New Goodlett Water System	Greenbelt MIWA
RRA Northeast Quanah Water System	Greenbelt MIWA
RRA Southwest Quanah Water System	Greenbelt MIWA
Sheppard Air Force Base	City of Wichita Falls
Thalia WSC	City of Crowell Greenbelt MIWA

Receiver Public Water System	Provider WUG
Town Of Pleasant Valley	City of Wichita Falls
TPWD Copper Breaks State Park	Greenbelt MIWA
Wichita Valley WSC	City of Archer City City of Iowa Park City of Wichita Falls

Source: Texas Commission on Environmental Quality: Water Utility Database, URL: https://dww2.tceq.texas.gov/DWW/, accessed July 2019.

7.5.2 Potential Emergency Interconnects

The existing water systems within the region were evaluated for potential to implement additional emergency interconnects. Due to the number of interconnects that have already been implemented, limited opportunity for additional interconnects are feasible.

7.6 Emergency Responses to Local Drought Conditions or Loss of Municipal Supply

Texas Statute §357.42(g) requires regional water planning groups to evaluate potential temporary emergency water supplies for all County-Other WUGs and municipalities with 2010 populations less than 7,500 that rely on a sole source of water. The purpose of this evaluation is to identify potential alternative water sources that may be considered for temporary emergency use in the event that the existing water supply sources become temporarily unavailable due to extreme hydrologic conditions such as emergency water right curtailment, unanticipated loss of reservoir conservation storage, or other localized drought impacts.

This section provides potential solutions that should act as a guide for municipal water users that are most vulnerable in the event of a loss of supply. This review was limited and did not require technical analyses or evaluations following in accordance with 31 TAC §357.34.

7.6.1 Emergency Responses to Local Drought Conditions

Table 7-5 presents temporary responses that may or may not require permanent infrastructure. It was assumed in the analysis that the entities listed would have approximately 180 days or less of remaining water supply. Table 7-5 is followed by a discussion of the alternative drought water supply strategies.

Table 7-5: Emergency Responses to Local Drought Conditions in Region B

Entity											Implementation Requirements		
Water User Group Name	County	2010 Population	2020 Demand (AF/year)	Drill additional groundwater wells	Brackish groundwater limit treatment	Brackish groundwater desalination	Emergency interconnect	Other named local supply	Trucked - in water	Voluntary transfer from irrigation	Type of infrastructure required	Entity providing supply	Emergency agreements already in place
Archer City	Archer	2,022	263	*	*		*		*			Wichita Falls	*
Holliday	Archer	1,786	231	*	*		*		*			Wichita Falls	*
Lakeside City	Archer	1,077	125	*	*		*		*			Wichita Falls	*
Scotland	Archer	501	194	*	*		*		*			Wichita Falls	*
Wichita Valley WSC	Archer	2,994	221	*	*		*		*			Wichita Falls	*
Windthorst WSC	Archer	1,266	294	*	*		*		*			Bowie	*
Seymour	Baylor	2,692	490	*	*		*		*			Baylor WSC	*
Dean Dale WSC	Clay	2,151	163	*	*		*		*			Wichita Falls	*
Henrietta	Clay	3,374	664	*	*		*		*				
Windthorst WSC	Clay	227	140	*	*		*		*			Bowie	*
Paducah	Cottle	1,458	290	*	*		*		*				
Crowell	Foard	1,137	138	*	*		*		*			Greenbelt	*
Quanah	Hardeman	2,981	396	*	*		*		*			Greenbelt	*
Bowie	Montague	5,305	995	*	*		*		*				
Nocona	Montague	3,321	740	*	*		*		*				

Entity											Implementation Requirements		
Water User Group Name	County	2010 Population	2020 Demand (AF/year)	Drill additional groundwater wells	Brackish groundwater limit treatment	Brackish groundwater desalination	Emergency interconnect	Other named local supply	Trucked - in water	Voluntary transfer from irrigation	Type of infrastructure required	Entity providing supply	Emergency agreements already in place
Saint Jo	Montague	898	155	*	*		*		*				
Dean Dale WSC	Wichita	1,248	81	*	*		*		*			Wichita Falls	*
Electra	Wichita	3,206	884		*		*		*			Wichita Falls	*
Iowa Park	Wichita	6,678	884		*		*		*			Wichita Falls	*
Wichita Valley WSC	Wichita	3,159	370	*	*		*		*			Wichita Falls	*
Olney	Young	3,429	556	*	*		*		*				*
County Other													
Windthorst	Archer	409		*	*				*				
Byers	Clay	534		*	*		*		*			Dean Dale WSC	*
Petrolia	Clay	808		*	*		*		*				
Chillicothe	Hardeman	796		*	*		*		*			Greenbelt	*
RRA Goodlett Water System	Hardeman	58		*	*				*			Greenbelt	*
RRA New Goodlett Water System	Hardeman	50		*	*				*			Greenbelt	*
RRA Northeast Quanah Water System	Hardeman	199		*	*				*			Greenbelt	*
RRA Southwest Quanah Water System	Hardeman	51		*	*				*			Greenbelt	*
RRA Foard County Water System	Foard	225		*	*				*			Crowell/ Greenbelt	*

Entity											Implementation Requirements		
Water User Group Name	County	2010 Population	2020 Demand (AF/year)	Drill additional groundwater wells	Brackish groundwater limit treatment	Brackish groundwater desalination	Emergency interconnect	Other named local supply	Trucked - in water	Voluntary transfer from irrigation	Type of infrastructure required	Entity providing supply	Emergency agreements already in place
City Of Lakeside City	Wichita			*	*				*			Wichita Falls	*
RRA Lockett Water System	Wilbarger	638		*	*				*			Vernon	*
RRA Box Community Water System	Wilbarger	127		*	*				*			Vernon	*
RRA Hinds-Wildcat	Wilbarger	160		*	*				*		Pipeline and pump station	Vernon	

7.6.2 Voluntary Transfer of Irrigation Rights

An additional evaluation was conducted which considered voluntary transfer of irrigation rights as an emergency response to local drought conditions. Voluntary transfer of irrigation rights is the payment for temporary transfer of local irrigation supplies for other uses. Voluntary transfer or "irrigation suspension" programs have been implemented successfully in Edwards Aquifer near San Antonio. Similar strategies are not considered viable in Region B, as during drought the WCWID No. 2 has already curtailed water use, conserving the remaining surface water quantities for municipal use. In addition there are not groundwater systems that would allow for such a water transfer because the groundwater sources are not as regionally connected as the Edwards Aquifer.

7.6.3 Brackish Groundwater

Brackish groundwater was evaluated as a temporary source during an emergency water shortage. Some brackish groundwater is found in various locations throughout the region. Due to water quality concerns many system have abandoned or limited use of existing brackish groundwater sources. In some cases these could be utilized during severe drought and blended with other sources. Required infrastructure would include some additional wells, potential treatment facilities, and conveyance facilities.

7.6.4 Drill Additional Local Groundwater Wells and Trucking in Water

In the event that the existing water supply sources become temporarily unavailable, drilling additional groundwater wells and trucking in water are optimal solutions. Table 7-5 presents this option as viable for all entities listed.

7.7 Region-Specific Drought Response Recommendations and Model Drought Contingency Plans

As required by the TWDB, Region B shall develop drought recommendations regarding the management of existing groundwater and surface water sources. These recommendations must include factors specific to each source as to when to initiate drought response and actions to be taken as part of the drought response. These actions should be specified for the manager of a water source and entities relying on the water source. Region B has defined the manager of water sources as the entity that controls the water production and distribution of the water supply from the source. For purposes of this assessment, a manager must also meet the TCEQ requirements for development of Drought Contingency Plan. Entities that rely on the water sources include customers of the water source manager and direct users of the water sources. A list of each surface water source in Region B and the associated drought triggers was provided in Section 7.3.

7.7.1 Drought Trigger Conditions for Groundwater Supplies

In general, groundwater supplies are somewhat localized to the users of these sources. As noted in Section 7.4, some public water providers utilize groundwater and have developed DCPs that are specific to their water supplies. However, there are many individual groundwater users not connected to a public water system or located within a groundwater conservation district. To convey drought conditions to all users of these resources in Region B, the RWPG proposes to use the Drought Monitor. This information is easily accessible and updated regularly. It does not require a specific entity to monitor well water levels or stream gages. It is also geographically specific so that drought triggers can be identified on a sub-county level that is consistent with the location of use. Region B adopted the nomenclature from the Drought Monitor for corresponding drought triggers. Table 7-6 shows the drought stages adopted by the U.S. Drought Monitor and the associated Palmer Drought Index.

Table 7-6 Drought Severity Classification

Category	Description or Stage	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

U.S. Drought Monitor: https://droughtmonitor.unl.edu/About/WhatistheUSDM.aspx

For groundwater supplies, Region B recognizes that the initiation of drought response is the decision of the manager of the source and/or user of the source. Region B recommends the following actions based on each of the drought stages listed in Table 7-6:

- 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.

7.7.2 Model Drought Contingency Plans

Model drought contingency plans were developed for municipal and irrigation entities in Region B and are available online through the Region B website under the Misc Documents tab within Publications (http://regionbwater.org/). Each plan identifies four drought stages: mild, moderate, severe and emergency. Some plans also include a critical drought stage. The recommended responses range from notification of drought conditions and voluntary reductions in the "mild" stage to mandatory restrictions during an "emergency" stage. Each entity will select the trigger conditions for the different stages and the appropriate response. Entities should use the TAC 228 rules mandated by the TCEQ as the guideline in development of these plans.

7.8 Drought Management Water Management Strategies

Drought management is a temporary strategy to conserve available water supplies during times of drought or emergencies. This strategy is not recommended to meet long-term growth in demands, but rather acts as means to minimize the adverse impacts of water supply shortages during drought. The TCEQ requires drought contingency plans for wholesale and retail public water suppliers and irrigation districts. A drought contingency plan may also be required for entities seeking State funding for water projects. Region B does not recommend specific drought management strategies. Region B recommends the implementation of DCPs by suppliers when appropriate to reduce demand during drought and prolong current supplies. Region B also recommends the implementation of conservation measures for all users to conserve water resources for the future.

7.9 Other Drought Recommendations

One of the challenges with drought in Region B is that the response to drought and associated impacts can vary depending upon the timing of the drought. Droughts that occur during the growing season can have a greater impact than drought occurring at other times. Since irrigated agriculture accounts for a large percent of the water use in the region, the impacts of agricultural droughts on water supplies can be significant.

To be better prepared for future droughts, Region B has the following recommendations:

- Municipal water users that rely on groundwater should consider protecting water supplies from competition through the acquisition of additional water rights and/or expansion of current well fields.
- To minimize potential catastrophic failure of an entity's water system, the entity should provide sufficient resources to maintain its infrastructure in good condition. Region B recognizes that water main breaks and system failures do occur, but with proper maintenance these may be able to be reduced.
- Water users should continue to use water efficiently to conserve limited resources on a year round basis, so that conservation becomes standard practice.

Region B provides the following recommendations to the DPC and regarding the State Drought Preparedness Plan:

- The DPC information should be maintained in the Texas Division of Emergency Management (TDEM). As such, information on drought status should be provided at https://tdem.texas.gov/. In reviewing the information provided on this site there is no mention of drought as an emergency condition. This is an oversight that should be addressed. At a minimum, this internet site should provide a link to https://www.drought.gov/drought/states/texas, which provides access to current drought status information. A link to the TWDB Drought Dashboard (https://waterdatafortexas.org/drought) should also be provided.
- The quarterly DPC reports are housed on the site of the State Climatologist (https://climatexas.tamu.edu/drought/index.html). However, there is no link between the TDEM site and the State Climatologist site that would provide quick access to these reports. In addition, the State Climatologist site does not provide DPC reports after the Fall, 2018, or two years before the date of this plan. It is not known whether these reports were not produced or if they have not been provided with links added to the site. The DPC should produce quarterly reports, as required.
- A comprehensive State Drought Preparedness Plan was not found at the TDEM web site, the State Climatologist web site, or the TWDB web site. The DPC shall develop and implement a comprehensive State Drought Preparedness Plan as required by the Texas Water Code, Section 16.0551 and it should be accessible through the TDEM web site.

References

[1] Drought Dashboard, Water Data for Texas, Texas Water Development Board, https://waterdatafortexas.org/drought .

[2] Drought page, Office of the Texas State Climatologist, https://climatexas.tamu.edu/drought/index.html .

[3] National Climatic Data Center: PHDI Divisional Data, URL: ftp://ftp.ncdc.noaa.gov/pub/data/cirs/climdiv/climdiv-phdidv-v1.0.0-20190604, accessed July 2019.

[4] National Drought Mitigation Center: U.S. Drought Monitor, URL: http://droughtmonitor.unl.edu/, accessed July 2019.

[5] Texas Administrative Code, Title 30, Chapter 288.

[6] Texas Commission on Environmental Quality: Water Availability Models, URL: http://www.tceq.texas.gov/permitting/water_rights/wam.html, accessed May 2014.

[7] Texas Department of Emergency Management, https://tdem.texas.gov/ .

[8] Texas Water Code, Section 16.0551.

[9] Texas Water Development Board: Region-B Planning Region Reservoirs, URL: https://www.waterdatafortexas.org/reservoirs/region/region-b, accessed July 2019.

CHAPTER 8

UNIQUE STREAM SEGMENTS AND RESERVOIR SITES AND OTHER RECOMMENDATIONS

2021 FINAL PLAN

REGION B

OCTOBER 2020

CHAPTER 8

UNIQUE STREAM SEGMENTS AND RESERVOIR SITES AND OTHER RECOMMENDATIONS 2021 FINAL PLAN REGION B

8.1 Introduction

As a part of the revised plan, this chapter identifies and makes recommendations that the Regional Water Planning Group deems vital to the management and conservation of the water resources in Region B.

8.2 Discussion of Regional Issues

In addition to the specific water management strategies recommended for Region B in Chapter 5 of the plan, there were several other issues that the Regional Water Planning Group deemed to be significant water management concepts to be given further consideration as part of the Region B Plan. The Chloride Control Project on the Wichita and Pease Rivers is a water management strategy with high regional support. Other strategies that enhance and/or increase the existing supplies in the region, such as land stewardship (brush management), groundwater recharge enhancement, and increased conservation storage for Lake Kemp, are each potentially feasible management strategies throughout and perhaps beyond the 50 year planning horizon.

Senate Bill 1 requires future projects to be consistent with the approved regional water plan to be eligible for TWDB funding and TCEQ permitting. However, it is the intention of the RWPG that surface water uses that will not have a significant impact on the region's water supply and water supply projects that do not involve the development of or connection to a new water source are deemed consistent with the regional water plan even though not specifically recommended in the plan.

8.2.1 Chloride Control Project

Improvement in the quality of this substantial water source would increase the reliability of the City of Wichita Falls system and reduce their treatment costs. It could also facilitate more diverse and expanded agricultural use and more efficient industrial use.
Also, in the long term, as chloride control facilities are constructed on the Pease River the potential exists for another freshwater supply reservoir on the Pease River near Crowell in Foard County.

8.2.2 Land Stewardship

Land stewardship is the practice of managing land to conserve or enhance the ecosystem values of the land. It is a benefit to the state's natural resources by improving watershed productivity through increased surface water runoff and groundwater recharge. Land stewardship is a practice that is supported and encouraged by Region B.

Some land stewardship practices that are most applicable in Region B include managed grazing, water enhancement through brush control, erosion management, riparian management, and stream bank protection. One area of concern in Region B is the encroachment of brush in the watersheds of water supply reservoirs. The U.S. Natural Resource Conservation Service (NRCS) estimates that brush in Texas uses about 10 million acre-feet of water annually compared to the 15 million acre-feet per year currently required for human use.

Based on the results of the completed studies, the regional planning group will continue to evaluate the potential effects of land stewardship strategies, and in particular water enhancement through brush control. It is anticipated that the effectiveness of these strategies will be reflected through increased water flow and improved ecosystem components such as wildlife, livestock production, aesthetics and land values.

8.2.3 Recharge Enhancement

Recharge enhancement is the process in which surface water is purposefully directed to areas where permeable soils or fractured rock allow rapid infiltration of the surface water into the subsurface to increase localized groundwater recharge. This would include any man-made structure that would slow down or hold surface water to increase the probability of groundwater recharge.

In Region B, groundwater is a major source of water for much of the western portion of the region. The Seymour Aquifer, which is generally unconfined, is fairly responsive to local recharge and may benefit from enhanced recharge programs. Further study is needed to determine the applicability of such programs in Region B, the quantity of increased groundwater supplies that may result from enhanced recharge, and the potential impacts to existing surface water rights.

8.2.4 Sediment Control Structures

The Wichita River Basin in Region B could potentially benefit from sediment control structures and other land management practices that reduce sediment loading to streams. The Region B Planning Group recommends that the state support both federal and state efforts to rehabilitate existing sediment control structures and encourage funding and support for the construction of new structures and other land management practices in watersheds that would produce the greatest benefits.

8.3 Designation of Unique Stream Segments and Reservoir Sites

In accordance with TAC Section 357.8, the Regional Water Planning Group is not required, but may include in the adopted regional water plan recommendations for river and stream segments of unique ecological value, in addition to unique sites for reservoir construction. Such designation would provide for protection of these specific sites to the extent that a state agency or political subdivision may not obtain a fee title or an easement that would destroy the unique ecological value of the designated stream segment or significantly prevent the construction of a reservoir on a designated site.

8.3.1 Unique Stream Segments

Within Region B, the Texas Parks & Wildlife (TPWD) has suggested that certain stream segments of the Middle Pease River in Cottle County, the Pease River in Foard County, and the Red River from the Wichita/Clay County line upstream through Hardeman County be considered for recommendation as stream and/or river segments of unique value. The TPWD believes that each of these segments satisfy at least one of the designation criteria defined in Senate Bill 1.

Of the stream segments suggested by the TPWD, two are located within areas that currently offer protections and one segment lies in Oklahoma:

- Middle Pease River segment is located in the Matador Wildlife Management Area
- Pease River segment is located in Copper Breaks State Park
- Red River segment is located in Oklahoma

The Region B Water Planning Group is committed to the protection and conservation of unique and sensitive areas within the region. To that end, the consensus of the planning group is that a more comprehensive study with supporting data is necessary to accurately characterize and evaluate the listed stream/river segments or other stream segments in order to determine whether it is appropriate to recommend segment for designation as being unique.

There is still some concern as to the impact of the designation and it is not clear what governmental or private activities, other than reservoir construction, might be subject to additional constraints or limitations as a result of unique stream segment designation. It is also not clear what geographic extent might be impacted by the designation. For example, is the entire watershed of the designated stream subject to additional limitations, and how far upstream of the designated stream would limitations apply? The Region B Water Planning Group suggests that the Legislature may wish to clarify their intent regarding the designations.

8.3.2 Reservoir Sites

It is generally recognized that studies over the last 40 years have identified perhaps the last remaining reservoir site within Region B in which the water quality of the watershed is adequate for municipal use. This site, known as the Ringgold Reservoir site, is located on the Little Wichita River in Clay County, approximately one half mile upstream from the confluence with the Red River.

This site is recognized as a site of unique value in the 2007 State Water Plan and is currently protected under the provisions of §16.051 of the Texas Water Code as amended by SB3 of the 80th Legislature. Lake Ringgold is a recommended water management strategy for Wichita Falls

(Chapter 5) and with the passage of House Bill 1042, 84th Legislative Session should remain protected as a unique reservoir site within the region, until applications and permits are filed even though it may not be required until late in the planning period.

8.4 Discussion of Regulatory and Legislative Actions

To facilitate the orderly development, management, and conservation of water resources within the region, and to assist the region in preparing for and responding to drought conditions, the Region B Water Planning Group believes that the regulatory agencies and legislature should consider certain actions relating to water quality and funding issues which affect Region B.

8.4.1 Regulatory Review of Nitrate MCL

In Region B, there are a number of small user groups which utilize water with nitrate levels in excess of 10 mg/l. For the most part this supply is their only source of water, and advanced treatment for the removal of nitrates is very costly. Presently these systems employ bottled water programs for customers that may be sensitive to nitrate concentrations (pregnant women and infants).

It is the consensus of the Region B Water Planning Group that the regulatory agency review its MCL standards for smaller systems which have no cost effective means to comply with the current nitrate MCL of 10 mg/l, and consider funding new studies to determine the health effects of nitrates in drinking water.

8.4.2 Funding for Comprehensive Studies

In preparing the Region B Water Plan there are several regional water planning, management, and conservation related issues which will require additional funding for data collection and administrative activities in order to adequately assess their viability or feasibility as a cost effective management strategy for Region B. For example, additional funds are needed to further evaluate and cost-share in the implementation of brush management programs in an effort to increase water yields, to identify and designate unique stream segments and/or reservoir sites for protection of these areas, and to implement various other chloride control measures and wastewater reuse programs throughout Region B.

8.4.3 Conservation

Region B supports the efforts of the State-appointed Water Conservation Task Force, and encourages the practices of water conservation within the region and state. The Regional Water Planning Group also recognizes the differences in water use and needs among water users and different regions. Region B encourages the Legislature to allow each region to establish realistic, appropriate and voluntary water conservation goals for the region. These goals should only be established after sufficient data on water use have been collected using consistent data reporting requirements. The use of the measurement of gallons per capita per day is appropriate only for residential water use or as a guideline for historical trends for a single entity. Region B does not support the establishment of statewide standards for water use.

8.5 Summary of Regional Recommendations

In accordance with 31 TAC 357.7 (a)(9), 31 TAC 357.8, and 31 TAC 357.9, the following recommendations are proposed to facilitate the orderly development, management, and conservation of the water resources available within Region B:

It is recommended that the Chloride Control Project on the Wichita River and the Pease River be made a regional priority in order to enhance the water quality of Lake Kemp and Lake Diversion, and reclaim those lakes as a viable cost effective short term and long term regional water supply source.

- Based on the results of the Lake Kemp and Lake Arrowhead brush management studies, it is recommended that the State consider providing adequate funding to implement brush management and other land stewardship programs in an attempt to increase watershed yields.

- Region B recommends that the state support both federal and state efforts to rehabilitate existing sediment control structures and encourage funding and support for the construction of new structures and other land management practices in watersheds that would produce the greatest sediment control benefits.

- Region B recommends that no segments be designated as "Unique Stream/River Segments" at this time. Pending the results of comprehensive studies and clarification of the significance and impacts of designation, the Regional Water Planning Group may consider designations within the region in the future.

- Region B requests that the Legislature continue to extend the protections for unique reservoir sites in order to ensure that reservoir sites such as Lake Ringgold that are identified as water management strategies remain protected under the Texas Water Code until applications and permits are filed.

- It is recommended that the state fund the development, implementation, and evaluate the necessary management strategies adopted as part of this regional plan. This includes strategies identified to meet a specific need as well as general strategies to increase water supply in the region.

- It is recommended that the Legislature support the grass-roots regional water planning process enacted by SB1 and strongly encourages the process be continued with adequate state funding for all planning efforts including administrative activities and data collection.

- It is recommended that the state continue to fund agricultural water use data collection and agricultural water use management/conservation projects.

- Senate Bill 1 requires future projects to be consistent with the approved regional water plan to be eligible for TWDB funding and TCEQ permitting. It is recommended that surface water uses that will not have a significant impact on the region's water supply and water supply projects that do not involve the development of or connection to a new water source should be deemed consistent with the regional water plan even though not specifically recommended in the plan.

- With regards to conservation it is recommended that the Legislature continue to allow each region to establish realistic, appropriate, and voluntary water conservation goals as opposed to the establishment of statewide standards.

- Region B recommends that the gallons per capita per day (gpcd) calculation of water use be based on residential water use only.

- Given a new drought of record, firm water availability from existing and new surface water supplies may be overstated. Therefore it is recommended that funding be provided to update the hydrology for all Water Availability Models (WAMS) with additional funding for regular maintenance updates.

- With irrigation being such a large component of water use, it is recommended that the economic model be updated and that the future crop mix and base year irrigation demands be reevaluated.

CHAPTER 9

INFRASTRUCTURE FINANCING REPORT
REGIONAL WATER PLAN

2021 FINAL PLAN

REGION B

OCTOBER 2020

CHAPTER 9

INFRASTRUCTURE FINANCING REPORT
2021 FINAL PLAN
REGION B

9.1 Introduction

Section 357.44 of the Texas Administrative Code requires that RWPGs assess how local governments, regional authorities, and other political subdivisions would finance the implementation of water management strategies. This Infrastructure Financing Report (IFR) for Region B includes information on the costs and funding capabilities of the entities with preferred water management strategies recommended during this planning cycle. The purpose of this update is to:

- Determine the number of water user groups with identified needs for additional water supplies that will be unable to pay for their water infrastructure needs without some form of outside financial assistance;
- Determine how much of the infrastructure costs in the regional water plan cannot be paid solely using local utility revenue sources;
- Determine financing options proposed by political subdivisions to meet future water infrastructure needs (including the identification of any state funding sources considered); and
- Determine what role(s) the RWPGs propose for the state in financing the recommended water supply projects.

The two essential elements to the IFR are: (1) surveys and (2) RWPG recommendations on the State's role in financing water infrastructure projects.

9.2 Identification of Needs

As described in Chapter 4, water supply needs in Region B were identified for three different categories: quantity, quality, and reliability. The quantity category includes 27 water user groups that were identified to have projected shortages totaling 41,256 acre-feet per year by 2070. In addition, five municipal and manufacturing water user groups were identified as having projected safe supply shortages. Safe supply is defined as being able to meet the projected demands plus 20 percent of the demand.

The quality category includes those water user groups that have been identified as being dependent on water that does not meet primary drinking water standards and those water user groups who are dependent on high chloride supplies from Lake Kemp for agricultural use.

The reliability category includes those water user groups with physical system limitations and/or limitations in available supplies as compared to contracted peak demands. Table 9-1 shows the 32 water user groups identified as having one or more of the categories of need.

Table 9-1
Water Users with Identified Needs (Firm and Safe)

		Water Supply Needs		
User	**County**	**Quantity**	**Quality**	**Reliability**
Archer City	Archer	X		
MUD 1	Archer			X
SUD	Baylor			X
Bowie	Montague			X
County Other	Archer			X
County Other	Clay			X
County Other	Montague			X
County Other	Young	X		
Crowell	Foard			X
Electra	Wichita	X		
Harrold WSC	Wilbarger			X
Holliday	Archer	X		
Iowa Park	Wichita	X		
Irrigation	Archer	X	X	
Irrigation	Wichita	X	X	
Lakeside City	Archer	X		
Manufacturing	Hardeman	X		
Manufacturing	Wichita	X		
Manufacturing	Wilbarger	X		
Mining	Archer	X		
Mining	Montague	X		
Nocona Hills WSC	Montague			X
Olney	Young			X
Quanah	Hardeman			X
Red River Authority of Texas			X	X
Scotland	Archer	X		

		Water Supply Needs		
User	County	Quantity	Quality	Reliability
Sheppard AFB	Wichita			X
Steam Electric Power	Wichita	X		
Steam Electric Power	Wilbarger	X		
Vernon	Wilbarger	X		
Wichita Falls	Wichita	X		
Windthorst WSC	Archer	X		

9.3 Recommended Water Management Strategies

Water management strategies were developed for each of the 32 water user groups shown in Table 9-1, with input from each respective water user group. Conservation was a primary strategy for each of the water user groups indicating a need. However, in many cases it was evident that conservation alone would not meet the projected needs. Therefore, other strategies were developed based on the entities' need and supply availability and are further detailed in Section 5.5 of this plan. In some cases, multiple strategies for the water user group were developed and presented as preferred and alternative strategies. However, for the purpose of the IFR, only the preferred strategies were considered.

In addition to the individual water user group strategies developed, the Region B Water Planning Group adopted a regional strategy that would benefit many of the water user groups in the planning area whether they indicated a need or not. This strategy is the Wichita River Basin Chloride Control Project. This project has been a major factor in area water planning for several years and once completed would increase the volume of water available for municipal and industrial purposes throughout the region, as well as make the Wichita River water available for a broader range of agricultural activities. A more detailed description of the project can be found in Section 4.4.2 of this plan.

The Wichita River Basin Chloride Control Project is a regional project dependent upon 100 percent federal funding and has been in development for more than 50 years. It was not included in the list of individual water user group strategies nor is the capital cost of the project included in the projected regional costs.

Water quality is a primary concern for many users in Region B and affects water use options and treatment requirements. For evaluation of the strategies, it was assumed that the final produced water would meet existing state water quality requirements for the specified use.

The total estimated capital cost for infrastructure to meet the identified needs and implement the preferred strategies less the Wichita Basin Chloride Control project is projected to be $587,048,142.

9.4 Infrastructure Financing Surveys for Preferred Water Management Strategies

Infrastructure Financing Surveys were emailed to user groups that were determined to have a projected water quality and/or water quantity need. A total of 22 of the strategies developed were identified as preferred water management strategies, and 17 entities were formally surveyed for this report. Ten entities responded. In addition to the initial response, follow-up phone calls or emails were conducted to develop a better understanding of strategy implementation. The results of the IFR Survey (Contacts and Survey Results) are provided in Appendix J.

Table 9-2 provides a summary of the water user groups preferred strategies, projected capital costs, proposed funding sources(s), and amount each water user group is unable to finance internally.

Table 9-2
Preferred Water Management Strategies

Water User Group	Water Management Strategy	Capital Cost	Funding Source	Unable to Pay
Archer Co. Mining	Mining Conservation	$1,137,000	State Bonds	$0
Baylor Co. Mining	Mining Conservation	$38,000	State Bonds	$0
Baylor Co. SUD	Additional Groundwater Supply	$138,000	State Bonds	$0
Baylor Co. SUD	Municipal Water Conservation	$525,000	State Bonds	$0
City of Bowie	Indirect Reuse	$5,123,000	State Bonds	$0
City of Vernon	Additional Seymour Aquifer	$1,115,000	State Bonds	$0
City of Vernon	Water Conservation (Replace Transmission Pipeline)	$8,820,000	State Bonds	$0
City of Wichita Falls	Lake Ringgold	$442,867,000	State Bonds	$0
Clay Co. Mining	Mining Conservation	$1,852,000	State Bonds	$0
Cottle Co. Mining	Mining Conservation	$94,000	State Bonds	$0

Water User Group	Water Management Strategy	Capital Cost	Funding Source	Unable to Pay
Foard Co. Mining	Mining Conservation	$28,000	State Bonds	$0
Hardeman Co. Mining	Mining Conservation	$47,000	State Bonds	$0
King Co. Mining	Mining Conservation	$893,000	State Bonds	$0
Montague Co. Mining	Mining Conservation	$8,554,000	State Bonds	$0
Wichita Co. Mining	Mining Conservation	$150,000	State Bonds	$0
Wilbarger Co. Mining	Mining Conservation	$47,000	State Bonds	$0
Red River Authority of Texas	Automated Meter Infrastructure (AMI)	$1,430,000	State Bonds	$0
Red River Authority of Texas	Water Conservation (Water Loss Control)	$30,217	State Bonds	$0
Red River Authority of Texas	Water Conservation (Municipal)	$54,000	State Bonds	$0
Red River Authority of Texas	Treated Water Line	$3,546,000	State Bonds	$0
Steam Electric Power Wilbarger County	Alternative Cooling Technology	$101,500,000	State Bonds	$0
Wichita Co. WCID #2	WCWID No. 2 Canal Conversion to Pipeline	$9,059,925	Grants = 75% Internal = 25%	$6,794,944
		$ 587,048,142		**$ 6,794,944**

9.5 Financing Policy Recommendations

Based on comments received from various water user groups, other entities, and the general public during this planning cycle, and keeping in line with previous IFRs, the Region B Water Planning Group recommends:

> "The state funds the development and the implementation of the management strategies adopted as part of this Regional Water Plan. This includes strategies identified to meet a specific need as well as general strategies to increase water supply in the region."

The Regional Water Planning Group believes that this recommendation can be accomplished through the Texas Water Development Board's current programs.

CHAPTER 10

ADOPTION OF PLAN AND PUBLIC PARTICIPATION

2021 FINAL PLAN

REGION B

OCTOBER 2020

CHAPTER 10

ADOPTION OF PLAN AND PUBLIC PARTICIPATION
2021 FINAL PLAN
REGION B

10.1 Introduction

This chapter describes the plan approval process for the Region B Water Plan and the efforts made to encourage public participation in the planning process.

Special efforts were made in seeking input from the general public, water suppliers, and others with special interest regarding the water planning process for Region B.

10.2 Regional Water Planning Group

As required by Senate Bill 1 regional water planning groups were formed to guide the planning process. These groups were comprised of representatives of twelve specific interests:

- General Public
- Counties
- Municipalities
- Industry
- Agricultural
- Environmental
- Small Businesses
- Electric Generating Utilities
- River Authorities
- Water Districts
- Water Utilities
- Groundwater Management Areas

Table 10-1 below lists the 19 members of the Region B Water Planning Group, the interests they represent, their organizations, and their counties.

Table 10-1

Regional Water Planning Group - Area B			
Name	**Organization**	**Interest**	**County**
Heath Ownbey	W.T. Waggoner Estate	Agricultural	Wilbarger
Wilson Scaling	Scaling Ranch	Agricultural	Clay
Judge Mark Christopher	Foard County	Counties	Foard
Judge Randall C. Jackson	Archer County	Counties	Archer
Steve Lewis	American Electric Power	Electric Generating Utility	Wilbarger
J. K. (Rooter) Brite	J. A. Ranch	Environmental	Montague/All
Jerry L. Payne	Natural Resources Conservation Service (Retired)	Environmental	Clay
Jimmy Banks	Public	General Public	Wichita
Carrie Dodson	Gateway Groundwater Conservation District	Groundwater Management Area 6	Hardeman
Tracy Mesler	Upper Trinity Groundwater Conservation District	Groundwater Management Area 8	Montague
Tamela Armstrong	Alliance Power Company	Industries	Wichita
Darell Kennon	City of Vernon	Municipalities	Wilbarger
Russell Schreiber	City of Wichita Falls	Municipalities	Wichita
Mayor Pro Tem Gayle Simpson	City of Crowell	Municipalities	Foard
Randy W. Whiteman	Red River Authority of Texas	River Authorities	All
Dean Myers	Bowie Industries, Inc.	Small Business	Montague
Kyle Miller	Wichita County Water Improvement District No. 2	Water Districts	Wichita
Mike McGuire	Rolling Plains Groundwater Conservation District	Water Districts	Baylor
Tommy Holub	Baylor County Special Utility District	Water Utilities	Baylor

The RWPG-B Planning Board unanimously pledged to support the interest of the entire region as the primary objective in meeting the needs of the region as a whole. During the first round of planning there was an extensive public education and participation program that included drought contingency planning workshops with local water suppliers, numerous civic group and local presentations, surveys of water users in the region, as well as planning group meetings, public hearings, and an internet web site. For this update, the public education and participation program consists of:

- Planning Group Meetings and Hearings
- Internet Web Site
- Coordination with Wholesale Water Providers and Water User Groups
- Implementation of the Water Plan

10.3 Planning Group Meetings

The RWPG-B held 14 open public meetings and hearings from February 10, 2016 through September 2, 2020 with invitations going to each category of interest groups and water use entities within the region, including a current agenda for each meeting and encouraging attendance and participation in the process. The RWPG Board participated actively as a group during each meeting, relying upon information provided by its consultant group and was well informed on all matters concerning the regional planning area. Additionally, the RWPG-B held 6 various committee meetings during this planning cycle. A list of the public meeting dates and locations held is shown in Table 10-2.

Representatives from the Texas Water Development Board, the Texas Commission on Environmental Quality, the Texas Department of Agriculture, the Texas State Soil and Water Conservation Board, and the Texas Parks and Wildlife Department were regularly in attendance and other agencies were periodically represented and offered presentations. Some of these were agencies such as the U.S. Army Corps of Engineers, and State and Federal Legislators representing the local districts within the regional planning area. All meetings were posted in accordance with the Texas Open Meetings Act and the Public Information Act.

During each meeting, a presentation of materials, discoveries, and relevant issues were provided for discussion and deliberation prior to receiving a vote on any specific measures, action, or strategies to be taken on the part of the RWPG-B. Members of the public were given an opportunity to participate in discussions of individual agenda items, as well as to provide public comments prior to the close of each meeting. Minutes were prepared of all meetings and posted on the RWPG-B website and with the Texas Water Development Board.

Table 10-2

Region B Planning Group Meetings and Public Hearings		
DATE	**EVENT**	**LOCATION**
February 10, 2016	RWPG-B Public Meeting	RRA Office – Wichita Falls
May 4, 2016	RWPG-B Public Hearing	RRA Office – Wichita Falls
August 17, 2016	RWPG-B Public Meeting	RRA Office – Wichita Falls
February 1, 2017	RWPG-B Public Meeting	RRA Office – Wichita Falls
August 16, 2017	RWPG-B Public Meeting	RRA Office – Wichita Falls
January 10, 2018	RWPG-B Public Hearing	RRA Office – Wichita Falls
May 2, 2018	RWPG-B Public Meeting	RRA Office – Wichita Falls
August 22, 2018	RWPG-B Public Hearing	RRA Office – Wichita Falls
February 6, 2019	RWPG-B Public Meeting	RRA Office – Wichita Falls
June 26, 2019	RWPG-B Public Meeting	RRA Office – Wichita Falls
October 23, 2019	RWPG-B Public Meeting	RRA Office – Wichita Falls
January 22, 2020	RWPG-B Public Meeting	RRA Office – Wichita Falls
April 22, 2020	RWPG-B Public Hearing	*RRA Office – Wichita Falls
September 2, 2020	RWPG-B Public Meeting	*RRA Office – Wichita Falls

* Via Teleconference

10.4 Media Communications

The RWPG-B Board members promoted numerous media coverage events before the board in an effort to encourage public involvement and heighten awareness of concerns vital to the regional planning area.

The Times Record News (TRN) was invited to each meeting and attended most, which produced good summary coverage of agenda items being considered together with actions taken by the RWPG-B Board.

10.5 Internet Web Page

An Internet Web Page was designed and is hosted by the RWPG's administrative agency, the Red River Authority of Texas. It is used to disseminate information about the water resources within the region and to publish notices of meetings, hearings, and issues being considered and addressed by the RWPG Planning Board.

The web pages are maintained and updated at least quarterly, or as needed, to publicize current information of interest and solicit input from the viewers. The web site is located under the Water Quality and Planning Section at www.rra.texas.gov. or at www.regionbwater.org.

The web site contains numerous links to other pages of common interest for the viewer and begins with a front page that includes a publications library, regional data inventories, names and contact information for the RWPG-B, public notices, maps of the region, and links to the regional water planning rules and statutes.

10.6 Regional Water Plan Implementation Issues

Implementation issues identified for the *Region B Water Plan* include: 1) financial issues associated with paying for the proposed capital improvements, 2) identification of the governing authorities for general regional strategies such as land stewardship, recharge enhancement and weather modification, 3) public acceptance of selected strategies, and 4) public participation in water conservation measures that were assumed in this plan.

Financial Issues

It is assumed that the entities for which strategies were developed will utilize existing financial resources, incur debt through bond sales and/or receive state-supported financial assistance. Most likely the funding of identified strategies will increase the cost of water to the customers. The economic feasibility to implement the strategies will depend on the cost increases the customer base can assume. Some strategies may not be able to be implemented without state assistance. The funding mechanisms for entities with shortages are identified as part of the report on the various financing mechanisms, and included as Chapter 9.

Governing Authorities

In Region B there is an identified governing authority for each of the recommended strategies discussed in Chapter 5. However, for general strategies, such as land stewardship, no governing authority has been identified. As part of the feasibility of these strategies for Region B, a governing authority will need to be identified to implement such strategies.

Public Acceptance

The public has expressed minor concerns regarding using wastewater effluent for municipal supplies. Reuse strategies are proposed to meet demands for the City of Wichita Falls and the City of Bowie. While the final treated water supply from this strategy will meet or exceed the city's current water quality, the perception persists that the water would be of lesser quality. To gain public acceptance of wastewater reuse strategies for municipal use, additional public educational programs may be needed. The construction of Lake Ringgold has also received some negative comments from the citizens of Clay County.

Public Participation

The recommended strategies developed for this plan include a significant level of conservation to be implemented over the planning period. These assumed demand reductions were applied to municipal water uses. Some of the demand reductions will occur simply through improvements in technology. However, a moderate level of public participation is required to fully realize the expected conservation. If the conservation is less than expected, then there may be additional shortages that were not identified in this plan.

10.7 Plan Adoption Process

In accordance with Texas Administrative Code Chapter 357 and the relevant rules governing the water planning process, the Region B RWPG conducted a formal process for the adoption of the Regional Water Plan. Activities under this section are primarily along two main lines. The first series of activities are directly related to the adoption of the Initially Prepared Plan (IPP) and the second series of activities are related to the final adoption of the completed Regional Water Plan.

10.7.1 Initially Prepared Plan Adoption

On January 22, 2020 the RWPG met at a public meeting for consideration and adoption of the IPP. Following discussions, comments, and questions, the RWPG voted to adopt the IPP and submit the IPP to the TWDB for their review and comments, and to set a Public Hearing date for the IPP.

10.7.2 Public Hearing

On April 22, 2020 the RWPG held a Public Hearing via teleconference, at the offices of the Red River Authority of Texas to receive comments from the public on the IPP. During the public hearing eleven (11) speakers presented verbal public comments with the recording of those comments being available on the Region B website. All comments received during the hearing were directly or indirectly regarding Lake Ringgold, which is a recommended strategy for the City of Wichita Falls. The categories of comments focused on support, need for the project, project cost, alternative strategies evaluated, environmental impacts, cultural impacts, flooding, and the loss of private property. There were ten (10) commenters that expressed concerns about the project, and one (1) commenter that expressed support for the project.

In addition to the verbal comments received at the public hearing, written comments were also received from ten (10) commenters. Similar to the verbal public comments, the written public comments were directly or indirectly regarding Lake Ringgold. Four (4) expressed support for the Lake Ringgold project and six (6) expressed concerns regarding the project.

Furthermore, written comments on the IPP were received from three (3) public agencies including the Texas Water Development Board, Texas Parks and Wildlife Department, and the Texas State Soil and Water Conservation Board.

10.7.3 Response to Comments.

As required, all public agency, public hearing, and written comments received regarding the IPP were address and all comments along with the appropriate responses have been included in Appendix I of the Final Plan.

10.7.4 Final Regional Water Plan Adoption.

On September 2, 2020 at a public meeting, the RWPG reviewed and approved all comments and responses and on that same date, officially approved the Final Plan for submission to the TWDB on or before, November 5, 2020.

10.8 Conclusion

The Region B RWPG has attempted to maintain their commitment to public participation throughout the planning process, and believes that the public information and participation activities are important to the success of the regional planning initiatives in addition to all the data that was accumulated and analyzed. Finally, the RWPG recommends that both funding and public information/participation be encouraged throughout all subsequent planning processes.

CHAPTER 11

IMPLEMENTATION AND COMPARSION TO PREVIOUS REGIONAL WATER PLAN

2021 FINAL PLAN

REGION B

OCTOBER 2020

CHAPTER 11

IMPLEMENTATION AND COMPARSION TO PREVIOUS REGIONAL WATER PLAN
2021 FINAL PLAN
REGION B

11.1 Introduction

Chapter 11 provides a comparison of the current Regional Water Plan to the previous Plan, and a discussion of the differences between the two. This chapter includes a discussion on the differences between the two Plans and a description of strategies that have been implemented since the publication of the 2016 Plan. The RWPG encourages cooperation between water user groups for the purposes of achieving economies of scale through holding public meetings and posting planning group materials on the Region B website where all water user groups may obtain information on upcoming strategies that benefit the entire region.

11.2 Differences Between Previous and Current Regional Water Plan

The following sections will provide a discussion of changes from the 2016 Plan to the 2021 Plan. Specifically, these section address differences in:

- Removed and new water user groups
- Population projections
- Water demand projections,
- Drought of record and hydrologic modeling and assumptions,
- Groundwater and surface water availability,
- Existing water supplies for water users,
- Identified water needs for WUGs and WWPs, and
- Recommended and alternative water management strategies.

11.2.1 Removed and New Water User Groups

One of the largest changes between the 2016 Plan and 2021 Plan is the Texas Water Development Board (TWDB) definition of Water User Groups (WUGs). TWDB changed to a service area boundary (based on public water supplier boundaries) from political boundaries. For Region B this led to many of the smaller public water supply systems being named in the plan rather than aggregated as County-Other. Table 11-1 shows the removed WUGs, new WUGs and notes on where the removed/new WUGs were included in the 2016 plan.

Table 11-1: Removed and New Water User Groups for the 2021 Plan

County	Removed Water User Group	New Water User Group	Notes on Change from 2016 Plan
Archer		Archer County MUD 1	Previously County-Other
Archer, Baylor, Young		Baylor County SUD	Previously County-Other
Clay	Petrolia		Now County-Other
Clay, Cottle, Foard, Hardeman, King, Montague, Wilbarger		Red River Authority	Previously County-Other
Foard	Chillicothe		Now County-Other
Montague		Nocona Hills WSC	Previously County-Other
Wichita, Wilbarger		Harrold WSC	Previously County-Other
Wichita		Sheppard Air Force Base	Previously City of Wichita Falls

11.2.2 Population Projections

Population projections for the 2021 plan are based on the population adopted for the 2016 plan. The regional and county total population remained the same between the two plans, however individual WUGs may have changed since the TWDB moved from using city boundaries to service area boundaries. WUGs that serve an area larger than their city limits may have seen an increased population while those that serve only a portion of the city limits may have seen reduced population. The population comparison for Region B for the 2016 plan and the 2021 plan is not shown since it is the exact same.

11.2.3 Water Demand Projections

The water demands in the Region B 2021 plan decreased in 2020 in comparison to the 2016 plan by approximately 4 percent with essentially no change by 2070. For the most part, manufacturing and power are lower and livestock and municipal showed some increase in water demand. Mining demands were unchanged and irrigation demands are lower at the beginning of the planning period and higher at the end. Figure 11-2 shows the comparison of the water demands in the 2016 plan and 2021 plan and Table 11-2 shows the change in demands from the 2016 plan to the 2021 plan by use type.

Figure 11-1
Comparison of Region B Water Demand in 2016 and 2021 Plans

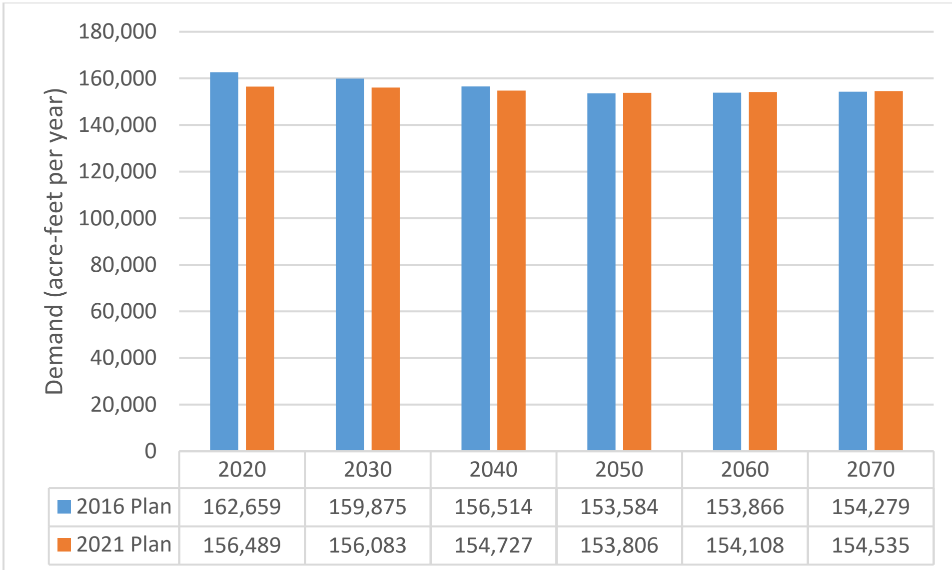


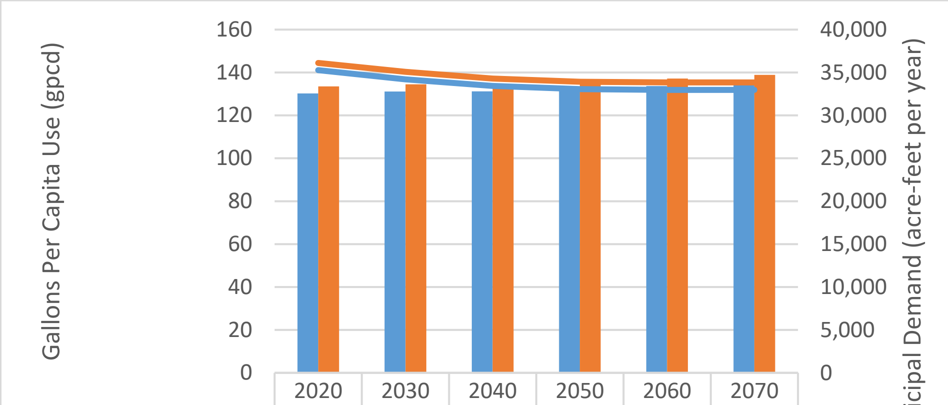
Table 11-2
Changes in Projected Demands from the 2016 Plan to the 2021 Plan by Use Type

Use Type	Change in Projected Water Demand (acre-feet per year)					
	2020	2030	2040	2050	2060	2070
Irrigation	-3,116	-738	1,596	3,884	3,884	3,884
Livestock	478	478	478	478	478	478
Manufacturing	-1,731	-1,757	-2,085	-2,381	-2,381	-2,381
Mining	0	0	0	0	0	0
Municipal	817	843	842	859	879	893
Steam Electric Power	-2,618	-2,618	-2,618	-2,618	-2,618	-2,618
Region B Total	-6,170	-3,792	-1,787	222	242	256

Note: Negative numbers indicate lower demand in the 2021 plan and positive numbers show higher demand in the 2021 plan.

Municipal demands for the 2016 plan are projected to increase over the planning period (2020-2070) slightly due to shifts in population from WUGs with lower gallons per capita per day to higher gallons per capita for day. As shown in Figure 11-2, the per capita use for the Region is slightly higher than in the 2016 plan due to shifts in population.

Figure 11-2
Comparison of the 2016 and 2021 Plan Projected Per Capita Use and Municipal Demand



	2020	2030	2040	2050	2060	2070
2016 Plan	32,563	32,784	32,793	32,996	33,414	33,827
2021 Plan	33,380	33,627	33,635	33,855	34,293	34,720
2016 Plan GPCD	141	137	134	132	132	132
2021 Plan GPCD	144	140	137	136	135	135

11.2.4 Drought of Record and Hydrologic Modeling Assumptions

The Wichita and Little Wichita River Basins experienced the end of a new drought of record since the previous planning cycle. This allowed for modeling the significant impacts on the surface water availability in the region this round. The drought has also affected groundwater supplies as greater demands are placed on the Seymour aquifer and the lack of precipitation has impacted the recharge of this source.

Hydrologic Modeling Assumptions

For the 2016 Plan, the historical hydrology for Lakes Arrowhead, Kemp, Kickapoo, Olney/Cooper, and Nocona were extended to include the period before and after the Red River WAM (1940-1947, 1999-2013). Reservoir yields were calculated using a Microsoft Excel model based on the WAM hydrology and extended hydrology. For the Wichita Falls System, a conditional reliability assessment was used to assess the potential impacts of on-going drought on supply. This reliability analysis was the basis of the supply used for the Wichita Falls System for the 2016 Plan. For the other reservoirs, the safe yield was used as the available supply.

In the 2021 Plan, the same Microsoft Excel models were used with the hydrology further extended through 2015 to capture the end of the new drought of record. For the Wichita Falls system, a safe yield was calculated with a 20 percent reserve capacity. The other reservoirs were calculated based on a one-year safe yield. All run-of river supplies were estimated using the respective WAM.

11.2.5 Groundwater and Surface Water Availability

Groundwater and surface water availability (not considering infrastructure or permit constraints) in Region B is higher in the 2021 Plan than in the previous plan. Groundwater supplies in Region B are greater than estimated for the 2016 Plan. This is due to the much higher Modeled Available Groundwater (MAG) estimates for the Seymour Aquifer in Hardeman and Foard Counties. There are also higher MAG values for the Blaine Aquifer in Cottle, Foard and Hardeman Counties.

In accordance with TWDB rules, the groundwater availability in the 2021 Plan is represented by the MAG estimate. Table 11-3 shows the changes in groundwater by county from the 2016 Plan. While the MAG values increased this round, the Region B Water Planning Group opted to not allocate those supplies based on local knowledge and disagreement with the TWDB assumptions used in the Groundwater Availability Models (GAMs). In addition, a new named minor aquifer (Cross Timbers) has been named with a significant extent in Region B. No MAG has been developed for this round of planning and the values for this round were developed by a Groundwater Technical Committee appointed by the Region B Water Planning Group.

Table 11-3
Change in Groundwater Availability by County from the 2016 Plan to 2021 Plan
- Values are in Acre-Feet per Year -

County	2020	2030	2040	2050	2060	2070
Archer	0	0	0	0	0	0
Baylor	3,405	3,543	3,190	2,944	2,820	3,143
Clay	0	0	0	0	0	0
Cottle	10,297	7,152	7,184	7,152	7,184	7,152
Foard	13,550	6,795	7,286	9,945	9,683	5,793
Hardeman	23,238	15,877	21,744	20,356	22,861	35,704
King	-10,440	-10,440	-10,440	-10,440	-10,440	-10,440
Montague	1,212	1,201	1,212	1,201	1,212	1,201
Wichita	0	0	0	0	0	0
Wilbarger	-971	-971	-971	-847	-475	-475
Total	**40,291**	**23,157**	**29,205**	**30,311**	**32,845**	**42,078**

The impacts of the drought on surface water supplies in Region B have been significant. The amount of surface water supply shown in the 2021 plan is about 35 percent lower than amount of surface water shown in the 2016 plan. Table 11-4 shows the change in reservoir supply between the 2016 and 2021 Plans. Differences in surface water availability were the result of the new drought of record conditions that reduced the reliable yield.

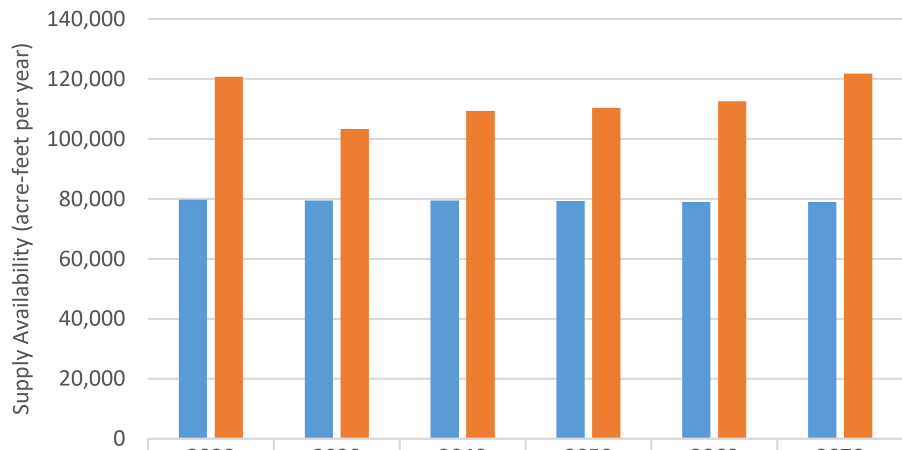
Table 11-4
Projected Change in Reliable Reservoir Supply from the 2016 to 2021 Plan in 2070

Reservoirs	2016 Plan	2021 Plan	Percent Change[1]
	(ac-ft/yr)		
Lake Kemp/Diversion	22,500	14,500	-55%
Lake Kickapoo/Arrowhead	13,241	11,900	-11%
Amon Carter Lake	1,100	830	-33%
Lake Electra	0	0	0%
Lake Nocona	1,260	1,260	0%
Olney Lake	620	130	-377%
Santa Rosa Lake	50	50	0%
North Fork Buffalo Cr.	0	0	0%
Total	**38,771**	**28,670**	**-35%**

[1] Negative numbers indicate lower supply in the 2021 Plan and positive numbers show higher supply in the 2021 Plan.

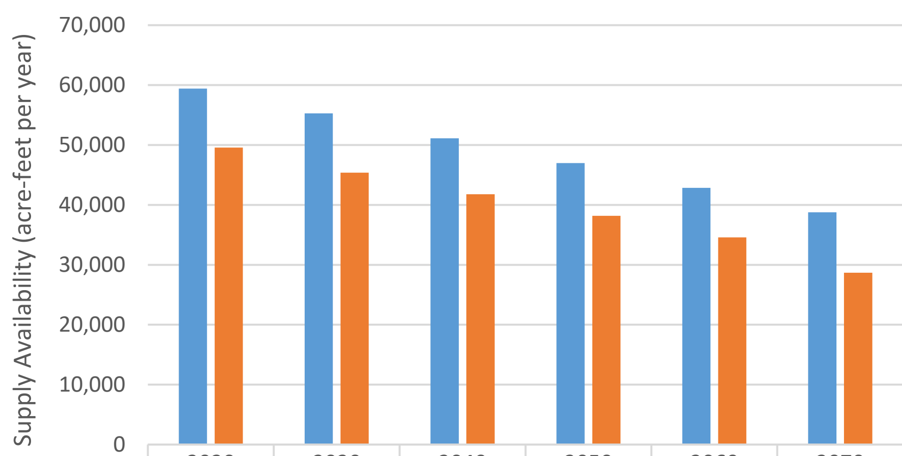
Overall, there was about a 22 percent increase in water availability throughout the Region between the 2016 and 2021 Plans. However, most of this increase is a result of increased MAG values that the Region B Water Planning Group did not allocate to WUGs. Figure 11-4 and Figure 11-5 show the differences in groundwater and surface water availability respectively.

Figure 11-3
Comparison of Groundwater Availability in the 2016 and 2021 Plans



	2020	2030	2040	2050	2060	2070
2016 Plan	79,713	79,475	79,440	79,319	78,976	78,976
2021 Plan	120,704	103,332	109,345	110,330	112,521	121,754

Figure 11-4
Comparison of Surface Water Availability in the 2016 and 2021 Plans



	2020	2030	2040	2050	2060	2070
2016 Plan	59,412	55,270	51,128	46,986	42,846	38,771
2021 Plan	49,574	45,393	41,792	38,192	34,591	28,670

11.2.6 Existing Water Supplies of Water Users

Existing supplies to users are based on the source availability and infrastructure developed to provide the water. Due to changes in source availability, some sources are no longer used or reduced supplies were available from existing sources. On the contrary, increasing water demands and drought have caused water users to adopt new supplies, including some that were implemented as strategies from the 2016 Plan.

New Existing Sources of Supply for Water Users

One new indirect reuse supply was implemented since the 2016 Plan. Water users with new sources of existing supply are shown in Table 11-5

Table 11-5
Water Users with New Sources of Existing Supply in the 2021 Plan

Water User	New Existing Supply
Wichita Falls	Indirect Reuse

Reduced Existing Surface Water Supplies

As mentioned previously in this chapter the recent drought reduced the available surface water supplies within Region B. Many of the water users with needs shown in the 2021 Plan also showed a need in the 2016 Plan as a result of reduced surface water supplies.

11.2.7 Identified Water Needs

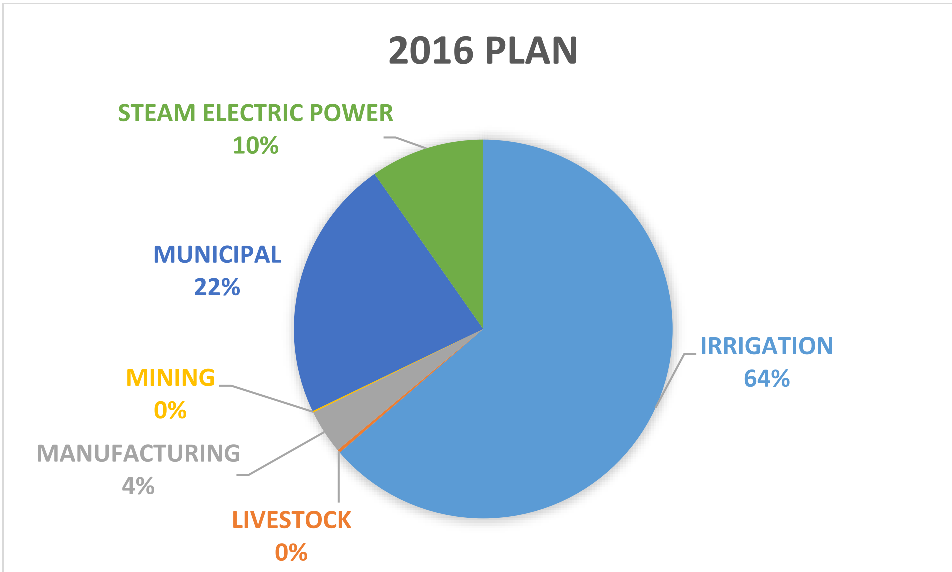
Due in large part to the implementation of Wichita Falls Lake Arrowhead Reuse Project, needs across Region B decreased forty-one percent in 2020 and are down nineteen percent in 2070, from the 2016 Plan to the 2021 Plan. Table 11-6 shows the individual water user groups with new needs or no needs in the 2021 Plan. In the 2021 Plan, eleven water user groups with safe supply needs in the 2016 Plan were removed and were replaced by eight new WUGs.

Table 11-6
Water Users with New Needs or No Needs for the 2021 Plan

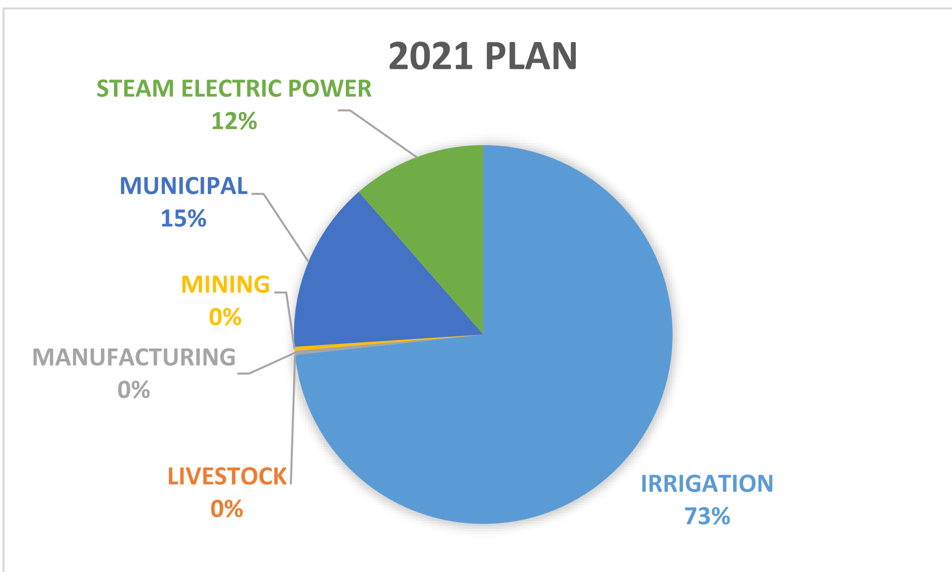
County with Need	New Need	No Need
Archer	Archer County MUD 1	
Archer	County-Other	
Archer, Wichita		Wichita Valley WSC
Baylor	Baylor County SUD	
Baylor		Irrigation
Baylor		Livestock
Clay, Wichita		Dean Dale SUD
Clay, Hardeman, Wilbarger	Red River Authority	
Foard		County-Other
Hardeman		County-Other
Hardeman		Irrigation
Montague	Nocona Hills WSC	
Wichita		Burkburnett
Wichita		County-Other
Wichita, Wilbarger	Harrold WSC	
Wichita	Sheppard Air Force Base	
Wilbarger		County-Other
Wilbarger		Irrigation
Young	Olney	

The needs were reduced for most categories with municipal and manufacturing with the largest decreases in needs. Most other categories remained nearly unchanged. Figure 11-6 below highlights the differences in need by use type in the two plans in the year 2070.

Figure 11-5
2070 Need by Use Type in the 2016 and 2021 Plans



Total Need = 49,253 acre-feet per year



Total Need = 41,256 acre-feet per year

11.2.8 Recommended and Alternative Water Management Strategies and Projects

New Water Management Strategies

Due to the recent new drought of record conditions, and the resulting diminishing surface water supplies, there are remaining water needs across the region which require new strategies and projects. The majority of the new strategies and projects were necessary to meet the needs of customers served by the City of Wichita Falls which provides for more than 80 percent of the total Region B municipal water demands. In the 2016 Plan there were 35 WUG's with needs and in the 2021 Plan that decreased to a total of 32 WUG's with needs. Shown in Table 11-7 are the new strategies and projects for WUG's that were not in the 2016 Plan.

Table 11-7
New Recommended Water Management Strategies and Projects in the 2021 Plan

Water User Group or Wholesale Provider	New Recommended Water Management Strategy
Baylor County SUD	New Groundwater Wells
Bowie	Indirect Reuse to Amon Carter
Red River Authority	Treated Waterline

Municipal Conservation

A somewhat different approach was used to evaluate municipal conservation between the 2016 and 2021 plans. In both cases there are two categories of conservation. Basic conservation is included in the demand projections and advanced conservation is planned as conservation above the basic conservation.

Basic conservation for the 2021 plan includes conservation resulting from adoption of the water conserving plumbing code, but also includes consideration of the federal clothes washer rules. Advanced conservation for the 2021 plan includes conservation derived from:

- Toilet rebate program
- Supplying showerhead/aerator kits,
- Or providing home water reports

It was assumed that water systems with a need would implement advanced conservation while those without needs would only implement basic conservation. The majority of advanced conservation is implemented in the latter portion of the planning period.

No Longer Considered Water Management Strategies and Projects

In addition to the new strategies and projects not included in the 2016 Plan, there were some strategies and projects that were included in the 2016 Plan; however, they are no longer being considered for the entity for various reasons. These are outlined in 11-8.

Table 11-8
Strategies and Projects No Longer Considered in the 2021 Plan

Water User Group or Wholesale Provider	Strategies from the 2016 Plan No Longer in the 2021 Plan
Vernon	Direct Reuse for Manufacturing
Olney	Indirect Reuse
Wichita Falls	Local Seymour Aquifer
Wichita Falls	Wichita River
Wichita Falls	Precipitation Enhancement

The region does not have any alternative water management strategies or projects in the 2021 plan or the 2016 plan.

<u>Cooperation Between WUGs to Achieve Economies of Scale</u>

Many of the WMSs and WMSPs that were included in the 2016 plan and continue in the 2021 plan are designed to serve the needs of multiple WUGs, because of the interconnections between WUGs. Therefore, many of the WMSs and WMSPs that produce larger volumes of supply serve the entire region and include WMSs like:

- Voluntary Transfers between WUGs with some entities such as Wichita Falls providing water to other WUGs as described in Chapter 5.
- Lake Ringgold providing increased surface water supply, primarily to Wichita Falls, but also to other WUGs through voluntary transfers.

Many WMSs will continue to address local needs of WUGs, and include WMSs like:

- Water conservation.
- Further development of existing groundwater – new wells.
- Local implementation of water reuses projects like Bowie.

11.3 Implementation of Previously Recommended Water Management Strategies

The following sections discuss those WMSs that were recommended in the 2016 Regional Water Plan and have been partially or completely implemented since that plan was published. These WMSs are included in the 2021 Plan as currently available supply. Implementation of the municipal conservation strategy is discussed under Section 11.2.8 with the discussion of differences in municipal demand projections.

11.3.1 City of Wichita Falls

In 2018, Wichita Falls completed an indirect potable reuse project utilizing the bed and banks of Lake Arrowhead which can supply up to 8 MGD. Treated wastewater from the Wichita Falls Resource Recovery Facility is pumped 17.5 miles to Lake Arrowhead where it is blended within the lake. Following blending, water is pumped to the Secondary Reservoir then diverted to the Jasper WTP and Cypress WTP for treatment and distribution as drinking water.

11.4 Conclusion

While the new drought of record ended since the last plan, the 2021 Region B Water Plan is similar to the 2016 Region B Plan. Many of the surface water supplies in the region were reduced but new reuse projects have been implemented to offset a portion of those reductions. In addition, groundwater supplies have increased specifically due to the use of the MAG's as a ceiling. Some strategies considered in the 2016 Plan were in response to the then on-going drought and were considered potential short-term emergency supplies to meet immediate needs but would not be long-term sustainable supplies. Many of the strategies no longer considered in this plan were those short-term emergency supplies.