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1.0 Introduction and Statutorily Required Elements

As required by Texas Water Code Chapter 36.1071, the High Plains Underground Water Conservation District No. 1 (the district) submits this updated groundwater management plan (the management plan) to the Executive Administrator of the Texas Water Development Board for review and approval. The following table contains a checklist and executive summary data which is included to facilitate the administrative review of the management plan.

Requirement	Rule	Comments on Information Submitted	Location
Paper Copy of Plan	31 TAC §356.6 (a)(1)	NA	Enclosed herein
Electronic Copy of Plan	31 TAC §356.6 (a)(1)	NA	Appendix A
1. Estimate the managed available groundwater in the district based on the desired future condition of the aquifers	31 TAC §356.5 (a)(5)(A) TWC §36.1071 (e)(3)(A)	Full text included in plan.	Section 2 Goal 9
2. Estimate the amount of groundwater being used within the district on an annual basis for at least the most recent five years.	31 TAC §356.5 (a)(5)(B) 31 TAC §356.2(2) TWC §36.1071(e)(3)(B)	The average annual amount of groundwater used within the district from all aquifers combined from 2000 through 2004 is estimated to be 2,894,040 acre-feet.	Table 3.1
3. Estimate the annual amount of recharge, from precipitation, to the groundwater resources within the district.	31 TAC §356.5 (a)(5)(C) TWC §36.1071(e)(3)(C)	The estimated annual amount of recharge from precipitation to the aquifers in the district is 639,574 acre-feet.	Table 4.1
4. For each aquifer, estimate the annual volume of water that discharges from the aquifer to springs and surface water bodies.	31 TAC §356.5 (a)(5)(D) TWC §36.1071(e)(3)(D)	The estimated annual volume of water that discharges from the aquifers to springs and any surface water bodies is 12,995 acre-feet.	Table 4.2
5. For each aquifer, estimate the annual volume of flow into, out of, and between aquifers in the district.	31 TAC §356.5 (a)(5)(E) TWC §36.1071(e)(3)(E)	The estimated annual volume of flow into, out of, and between the aquifers in the district is 103,241 acre-feet.	Tables 4.3, 4.4, 4.5

Requirement	Rule	Comments on Information Submitted	Location
6. Estimate the projected surface water supply within the district according to the most recently adopted state water plan.	31 TAC §356.5 (a)(5)(F) TWC §36.1071(e)(3)(F)	The projected surface water supply remains relatively constant with an annual average of 44,789 acre-feet.	Table 5.1
7. Estimate the projected total demand for water within the district according to the most recently adopted state water plan.	31 TAC §356.5 (a)(5)(G) TWC §36.1071(e)(3)(G)	The projected water demand decreases by approximately 12.6%, between 2010 to 2060.	Table 3.6
8. Consider the water supply needs that are included in the state water plan.	31 TAC §356.5 (a)(7) TWC §36.1071(e)(4)	The projected water supply needs increases from 971,421 acre-feet per year in 2010 to 1,927,006 acre-feet per year in 2060.	Table 6.1
9. Consider the water management strategies that are included in the state water plan.	31 TAC §356.5 (a)(7); TWC §36.1071(e)(4)	If fully implemented, the water management strategies recommended for use in the district could result in additional supplies up to 432,369 acre-feet per year in 2060.	Table 6.2
10. Develop actions, procedures, performance, and avoidance necessary to effectuate the plan, including specifications and proposed rules.	31 TAC §356.5 (a)(4); §356.6(a)(3); TWC §36.1071(e)(2)		Section 2.0 Appendix B
11. Include a certified copy of the district's resolution adopting the plan.	31 TAC §356.6 (a)(2)	The district's board of directors adopted the attached plan on February 23, 2010.	Appendix C
12. Provide evidence that the plan was adopted after notice and hearing.	31 TAC §356.6 (a)(5); TWC §36.1071(a)	Notice was posted with the Secretary of State, at the Lubbock County Courthouse, the district's principal office, and each county secretary's office on February 12, 2010. A hearing was held on February 23, 2010 at the district's principal office in Lubbock, Texas.	Appendix D

Requirement	Rule	Comments on Information Submitted	Location
13. Provide evidence that the district coordinated the development of the plan with all surface water management entities.	31 TAC §356.6 (a)(4); TWC §36.1071(a)	A copy of the district's plan was sent to all surface water management entities.	Appendix E
14. Provide any site-specific information used in developing the plan	31 TAC §356.5 (b); TWC §36.1071(h)	All hydrologic and planning data included in this plan was provided by the TWDB.	
Management goals required to be addressed:			
Provide the most efficient use of groundwater	31 TAC §356.5(a)(1)(A); TWC §36.1071(a)(1)	Full text included in plan.	Section 2.0 Goal 2
Control and prevent waste of groundwater	31 TAC §356.5(a)(1)(B); TWC §36.1071(a)(2)	Full text included in plan.	Section 2.0 Goal 3
Control and prevent subsidence	31 TAC §356.5(a)(1)(C); TWC §36.1071(a)(3)	NA - Full text included in plan.	Section 2.0 Goal 4
Address conjunctive surface water management issues	31 TAC §356.5(a)(1)(D); TWC §36.1071(a)(4)	Full text included in plan.	Section 2.0 Goal 5
Address natural resource issues that impact or are impacted by the use and availability of groundwater	31 TAC §356.5(a)(1)(E); TWC §36.1071(a)(5)	Full text included in plan.	Section 2.0 Goal 6
Address drought conditions	31 TAC §356.5(a)(1)(F); TWC §36.1071(a)(6)	Full text included in plan.	Section 2.0 Goal 7
Address conservation, recharge enhancement, rainwater harvesting, precipitation enhancement, and brush control	31 TAC §356.5(a)(1)(G); TWC §36.1071(a)(7)	Full text included in plan.	Section 2.0 Goal 8
Address in a quantitative manner the desired future conditions of the groundwater resources in the district	31 TAC §356.5(a)(1)(H); TWC §36.1071(a)(8)	NA - Full text included in plan.	Section 2.0 Goal 9
Identify the performance standards and management objectives for effecting the plan	31 TAC §356.5(a)(2)&(3); TWC §36.1071(e)(1)	Full text included in plan.	Section 2.0

1.1 District Creation

The Texas State Board of Water Engineers delineated the original boundaries of the district in March 1951. In 1951, voters in 13 Southern High Plains counties created the district in accordance with the Underground Water Conservation Districts Act passed by the Texas Legislature in 1949. After several annexation elections, the district now consists of Bailey, Cochran, Hale, Lubbock, Lynn and Parmer counties, and portions of Armstrong, Castro, Crosby, Deaf Smith, Floyd, Hockley, Lamb, Potter and Randall counties (see Figure 1). The district's jurisdictional boundary consists of 10,728 square miles or 6,865,920 acres.

1.2 District's Mission

As defined in statute, the purpose of the groundwater conservation districts in Texas is to provide for the conservation, preservation, and protection of the groundwater resources within its jurisdictional boundaries. The mission of the district is to provide sound management of groundwater resources and make every effort to insure that an abundant and high quality supply of potable water will be available for future water users.

Since its inception, the district's board of directors (the board) has upheld the philosophy that ownership of groundwater is a private property right, and that water conservation is best accomplished through its many public education and technical assistance programs. It is the board's belief that water users will do their part to effectively manage and conserve groundwater supplies if they know why and how to accomplish this goal.

1.3 Board of Directors and County Advisory Committees

Residents within the district are represented by a grassroots network of five elected and 75 appointed officials. The district is governed by a five-member board, elected to serve four-year terms by residents of the director's precinct they represent. In addition, a five-member county advisory committee is appointed by the board in each of the 15 counties in the district.

1.4 Groundwater Management Planning

In developing its management plan, the board considers historical groundwater use, water demand projections, current and projected water supply availability, and water supply needs to establish its policies. Rules promulgated by the board are carefully considered and are adopted only after considerable public input. These rules provide a fair and equal opportunity for all users to use groundwater for beneficial purposes while at the same time meeting the goals of the district.

The board also establishes the processes by which the district will monitor changes in supply and demand which affect the viability of the aquifers. This document is a dynamic management plan meant to be reviewed, evaluated and revised as necessary to ensure that the district's goals are met. As conditions change throughout time, the board will re-evaluate its policies and rules. Recent changes in Texas law related to groundwater management clearly illustrate the need to routinely review, evaluate, and revise district management plans and rules in order to meet new requirements and changed conditions. Even as this management plan was being developed, the district was working to meet new requirements resulting from the passage of House Bill 1763 (79th

Texas Legislature in 2005) including the establishment of desired future conditions for the aquifers under its jurisdiction. As soon as these new requirements have been fulfilled, this management plan will be revised to address all groundwater management requirements.

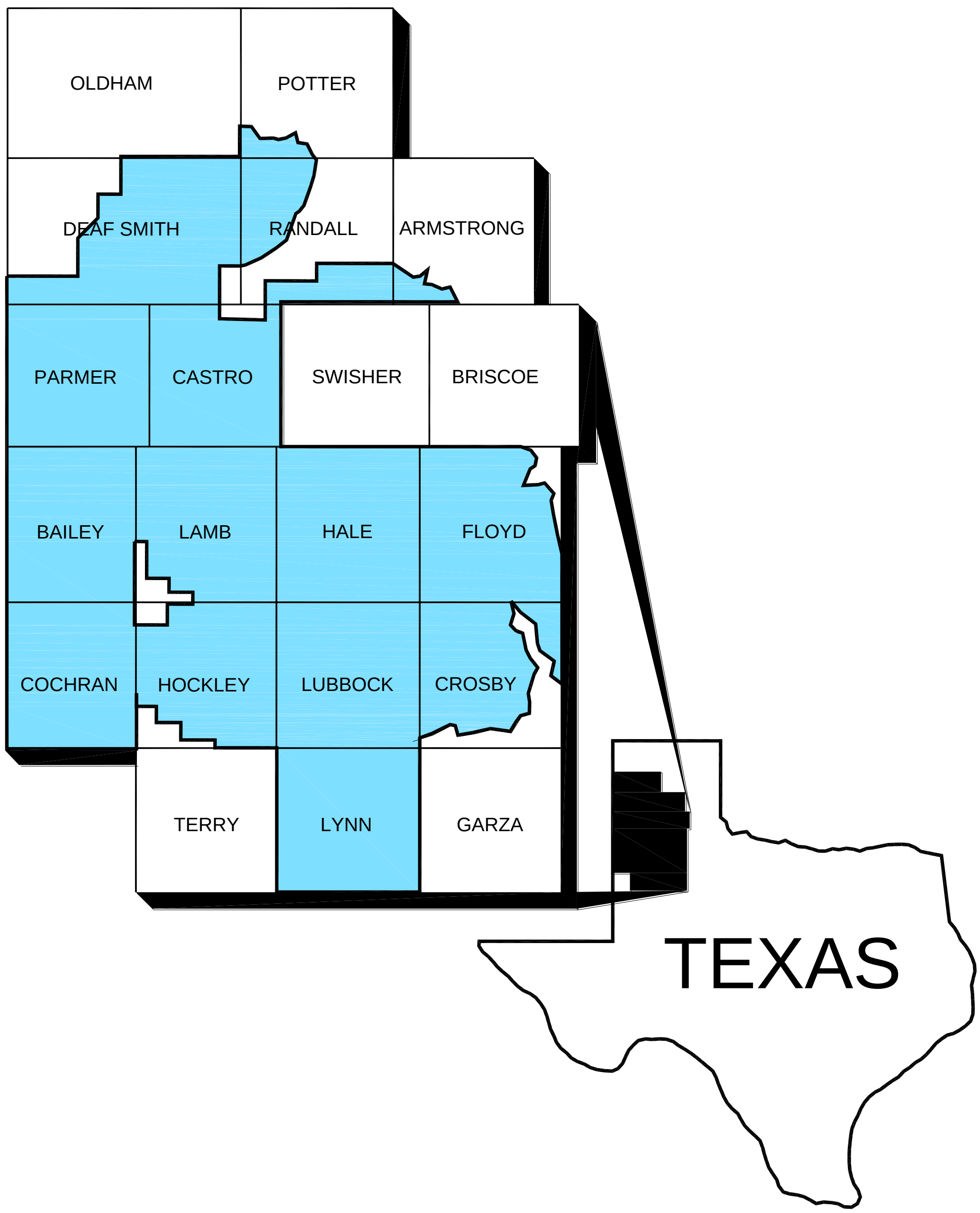

Figure 1. Jurisdictional boundaries

The goals, management objectives, and performance standards set forth in this document are considered by the board to be reasonable and prudent. Whenever the board determines that a change is needed, they will act accordingly after careful consideration of all the facts and after receiving public input.

1.5 Planning Horizon

This plan is a revision of the management plan adopted by the board on January 29, 2004. The Executive Administrator of the Texas Water Development Board certified it as administratively complete on June 21, 2004. This plan will remain in effect until an amended plan is adopted and approved, or September 17, 2019, whichever is earlier. The board will review the management plan at least every five years, as required by Texas Water Code Chapter §36.1072(e).

2.0 Actions, Procedures, Performance, and Avoidance Necessary to Effectuate the Plan

In order to effectuate the district's management plan, the district continually works to develop, maintain, review, and update written procedures and guidelines for the various activities contained in the plan. In order to monitor performance, (a) the General Manager routinely meets with staff to track progress on the various objectives and standards and, (b) on an annual basis, staff prepares and submits a report documenting progress made towards implementation of the plan to the board for their review and approval. Also, as needed, and at least annually, staff reviews district rules to ensure that all provisions necessary to implement the plan are contained in the rules. The board will make revisions to the rules as needed to manage and conserve groundwater resources within the district more effectively and to ensure that the duties prescribed in Texas Water Code and other applicable laws are carried out. A copy of the district's rules may be found on the district's website located at www.hpwd.com.

The district will work diligently to ensure that all citizens within the district are treated as equitably as possible. The district, as needed, will seek the cooperation of federal, state, regional, and local water management entities in the implementation of this plan and management of groundwater supplies within the district.

The district will continue to enforce its rules to conserve, preserve, protect, and prevent the waste of groundwater resources within its jurisdiction. Texas Water Code Chapter 36.1071(a)(1-9) requires that all management plans address the following management goals, as applicable:

- providing the most efficient use of groundwater;
- controlling and preventing waste of groundwater;
- controlling and preventing subsidence;
- conjunctive surface water management issues;
- natural resource issues;
- drought conditions;
- conservation, recharge enhancement, rainwater harvesting, precipitation enhancement, or brush control, where appropriate and cost-effective; and
- desired future conditions of the groundwater resources in a quantitative manner.

The following management goals have been developed and adopted to ensure the management and conservation of groundwater resources within the district's jurisdiction.

Goal 1: Maintain hydrologic data collection programs necessary to make informed decisions for the effective and efficient management and conservation of groundwater resources

A water level observation network was established several decades ago in order to allow the district to monitor trends in water levels in the Ogallala Aquifer located within the district. Data from the observation wells are used (1) to analyze historic and current trends in water level declines, including the volume of water remaining in the Ogallala Aquifer within the district; (2) to quantify annual depletion values for individual producers; (3) by the U.S. Internal Revenue Service to establish annual depreciation amounts for individual properties resulting from use of groundwater resources; and (4) by the board as it contemplates policy decisions regarding desired future conditions and resulting revisions to management plans and rules.

Management Objective 1.1 Monitor water levels

Estimate the volume of available groundwater by maintaining an observation well network of approximately one well per nine (9) square miles, or approximately 1,200 wells within the district.

Performance Standards

1.1a Measure, annually, the depth-to-water below land surface in each well in the observation well network in which it is possible to measure and record the depth-to-water. Wells which are temporarily not available for measurement will be noted as such by monitoring technicians. Wells which have been permanently abandoned will be removed from the network.

1.1b Increase the number of wells in the observation well network by a net increase of fifty (50) wells per year. The new wells will be located in areas where a need for greater data density has been documented.

1.1c Compare, annually, water level measurements to previous measurements and calculate the water level rise/decline in each well for the past year, the past five years and the past ten years, and prepare and disseminate representative hydrographs and depletion maps demonstrating the changes in water levels in the Ogallala Aquifer through the district's newsletter.

1.1d Maintain depth-to-water income tax depletion allowance database and annually supply data to landowners, as requested, and to U.S. Internal Revenue Service for approval.

Management Objective 1.2 Update, publish and distribute hydrologic atlases

At five-year intervals, construct and publish a hydrologic atlas for each county within the district and make the atlases available to the public. Each atlas will contain four maps and text explaining the maps. The maps will depict the approximate altitude of the base of the Ogallala Aquifer, the approximate altitude of the Ogallala Aquifer water table, the approximate altitude of land surface, and the approximate saturated thickness of the Ogallala Aquifer.

Performance Standard

1.2a Beginning in 2010 and every five years thereafter, utilizing water level measurements and other necessary topographic and hydrologic data, produce hydrologic atlases for all counties located in whole or in part within the district.

Goal 2: Provide the most efficient use of groundwater

The district maintains a qualified staff to assist water users in protecting, preserving, and conserving groundwater resources. The board has in the past and continues today to base its decisions on the best data available to treat all water users as equitably as possible. The board determines the programs and activities that it will undertake to provide the best possible water conservation and management services to the area. District rules are enforced to protect the quantity and quality of the groundwater and to prevent the waste of groundwater.

Management Objective 2.1 Issue well permits

The district will issue water well permits for all non-exempt water wells in accordance with its rules (see Texas Water Code §36.117 for definition of exempt wells).

Performance Standards

2.1a At each regularly scheduled board meeting, staff will report the number of new permit applications received by county recommended for approval by the general manager, as well as, any requests for exception to district rules.

2.1b Document in the annual report the number of compliance letters mailed to permit applicants requesting additional information or changes needed to comply with district rules, the number of follow-up letters required, and the number of permit application cases still open at year-end.

Management Objective 2.2 Measure pre-plant soil moisture

Staff will take soil moisture readings throughout the district in January of each year. Neutron moisture meters, or equivalent technology, will be used to gather data at six-inch intervals to a depth of six feet or to the caliche layer (whichever is first) and the measurements will be entered into the district data base. Contour maps illustrating soil moisture conditions will be produced and published before the next crop growing season and the information from the pre-plant soil moisture survey will be made available through the district's newsletter, website, and print/electronic media. Irrigators are encouraged to use the soil moisture maps as a guide prior to planting.

Performance Standards

2.2a No later than March each year, publish soil moisture maps that illustrate available soil moisture, soil moisture deficits, and other factors affecting soil moisture in the district's newsletter and on the district's web site. This information will also be made available to print/electronic media.

Goal 3: Control and prevent the waste of groundwater

One of the basic activities that the district has engaged in since its inception in order to conserve groundwater resources of the region is by controlling and preventing the waste of groundwater. Today this effort has expanded beyond waste in agricultural practices to include waste in municipal, industrial, commercial, and institutional settings.

Management Objective 3.1 Maintain an agricultural irrigation tailwater abatement program.

Monitor agricultural practices within the district to prevent and terminate the waste of groundwater that results from the release or loss of irrigation water (tailwater) during the irrigation season. The loss of irrigation water from land on which it is produced is a violation of state law and district rules. District rules, taken from state statue Texas Water Code §36.001(a)(8)(F), defines waste as it relates to irrigation tailwater as *"willfully or negligently causing, suffering, or permitting groundwater to escape into any river, creek, natural watercourse, depression, lake, reservoir, drain, sewer, street, highway, road or road ditch, or onto any land other than that of the owner of the well; or groundwater pumped for irrigation that escapes as irrigation tailwater onto land other than that of the owner of the well unless permission has been granted by the occupant of the land receiving the discharge."* If such an agreement is made, the water must move directly onto the neighbor's property without crossing property belonging to anyone else or public property.

Performance Standards

3.1a Document all irrigation tailwater complaints with photographs and written reports within three days of receipt of complaint.

3.1b Notify the owner and/or operator within seven days of documenting the violation that it is responsible for the tailwater and that a violation has occurred.

3.1c Document in the annual report the number of irrigation tailwater violation letters sent to, and the telephone contacts with the owners and/or operators, any cases resulting in legal action, and their final dispensation.

Management Objective 3.2 Promote efficient agricultural irrigation technologies

Most of the agricultural producers within the district are making a diligent effort to maximize the benefits of the precipitation they receive and to maximize their irrigation application efficiencies. Most irrigation systems in the Southern High Plains are designed to only supplement precipitation and not to meet the total crop water demand. During drought periods, the crop yield potential declines in proportional amounts to the amount of water lost during the irrigation application. Much of the district's educational efforts address improved irrigation application efficiencies by producers.

Performance Standards

3.2a Inventory and document the number of center pivot sprinkler systems in operation within the district once every five years.

3.2b In combination with Objective 3.3a, publish at least ten articles related to irrigation application efficiencies each year in the district's newsletter. (Note that this performance standard target of ten articles per year is based on the sum of articles addressing agricultural water conservation *and* municipal water conservation strategies.)

Management Objective 3.3 Address urban water waste

Increasing population, coupled with limited surface and groundwater supplies, make it important for area residents to make more efficient use of the region's water resources. The district supports the efforts of area municipalities to preserve the quality and quantity of their water reserves. The district offers a wide range of technical and educational materials to assist towns and cities in this effort.

Performance Standard

3.3a In combination with Objective 3.2b, publish at least ten articles discussing municipal water conservation each year in the district' newsletter. (Note that this performance standard target of ten articles per year is based on the sum of articles addressing agricultural water conservation *and* municipal water conservation strategies.)

Goal 4: Control and prevent subsidence

Due to the unconfined nature of the Ogallala Aquifer on the Southern High Plains, problems resulting from water level declines causing subsidence are not technically feasible. Furthermore, subsidence resulting from the dissolution of evaporate deposits underlying the Ogallala Aquifer within the district have not been documented within the historic period, nor are they anticipated. Based on these geologic and hydro-geologic characteristics of the Southern High Plains, the board has determined that this goal is not applicable to the district.

Goal 5: Address conjunctive surface water management issues

Surface water resources play a very important role in meeting municipal and industrial water demands within the district. The district coordinates with the surface water management agencies within the region by serving as a member of the Llano Estacado Regional Water Planning Group and through the support of municipal water conservation programs (see Management Objective 3.3).

Management Objective 5.1 Ensure coordination with surface water management agencies

The general manager will represent groundwater management interests of the district at all meetings and events of the Llano Estacado Regional Water Planning Group. Participation in the regional water planning process will ensure coordination with surface water management agencies that are also participating in the regional water planning process.

Performance Standard

5.1a The general manager will report on actions of the Llano Estacado Regional Water Planning Group as appropriate to the board, and staff will document significant actions of the planning group in the annual report.

Goal 6: Address natural resource issues

Protection, conservation, and management of the quantity and quality of the Ogallala Aquifer are important due to the implications that insufficient or inferior water resources have on health. The quantity of groundwater resources is addressed in Goal 1. Goal 6 is primarily focused on the protection of natural resources through the active protection of water quality in the Ogallala Aquifer. The district works to assist residents in protecting the quality of their groundwater resources.

Management Objective 6.1 Enforce district rules regarding illegal operation of wells

Staff will inspect all sites reported as being open and/or uncovered, abandoned, or deteriorating and follow through to ensure proper closure and/or repair in accordance with district rules.

Performance Standards

6.1a Within two working days of locating an open and/or uncovered well, staff will close the well opening with a suitable cap and attempt to notify the owner and/or operator that an open and/or uncovered well exists on the property.

6.1b Within two working days of locating a deteriorating or deteriorated well, staff will take action necessary to safely secure the well site and attempt to notify the owner and/or operator that deteriorating or deteriorated well exists on the property. The time required to complete these actions will be dependent upon the nature of the deteriorated well.

6.1c Within two working days of locating a abandoned well, staff will take action necessary to safely secure the well site and attempt to notify the owner and/or operator that an abandoned well exists on the property. The time required to complete these actions will be dependent upon the nature of the deteriorated well.

6.1d Document in the annual report the number of open and/or uncovered, abandoned and deteriorated wells reported and inspected, the number of notification letters mailed, the number of second notices mailed, the number of wells the district closed, and the number of well caps provided.

Goal 7: Address drought conditions

Drought conditions in recent years have reminded us of how dependent we are on precipitation and underscore the importance of irrigation application efficiency as it relates to crop yields and water conservation for municipal and industrial users.

Droughts occur and reoccur in the area, as do cycles of above average precipitation. The unpredictability of the amounts and timing of precipitation events make it very difficult to determine exactly how much groundwater the irrigator will need to pump to meet his crop water demands

Management Objective 7.1 Provide ongoing and relevant meteorological information

The district maintains a rain gauge network in order to monitor hydrologic conditions throughout the region. The district will make available through the its website and through its newsletter pertinent information to irrigators and municipalities with an emphasis on developing and current drought conditions.

Performance Standard

7.1a Maintain a rain gauge network located in conjunction with its soil moisture monitoring sites. The rain gauges will be read by staff five times per year on a regular basis and the results will be published during periods of drought on a monthly basis and annually otherwise in the district's newsletter.

Goal 8: Address conservation, recharge enhancement, rainwater harvesting, precipitation enhancement, and brush control

This goal, in its current form, is a new requirement for the management plan. Texas Water Code §36.1071(a)(7) requires that a management plan include a goal that addresses conservation, recharge enhancement, rainwater harvesting, precipitation enhancement, or brush control, where appropriate and cost-effective.

The district has a long, well established, and widely recognized program promoting water conservation, which utilizes a number of public information strategies to inform the public of the importance of water and water conservation.

This new goal requires that the district also address enhancement of recharge to the Ogallala Aquifer. The district supports best management practices such as rainwater harvesting, through its municipal water conservation programs, and as such, is included in management objectives and performance standards below detailing such activities. The district has historically, and will continue, to support brush control through the activities of Texas Soil and Water Conservation Board and their various local districts. As a result, the district has determined that it would be duplicative and not cost effective to establish a similar brush control program. Based on significant public input regarding a past precipitation enhancement program, the board has made a determination that this is not an activity that is appropriate or cost effective.

Management Objective 8.1 Prepare, produce and distribute monthly newsletter

Each year, 12 issues of the newsletter will be produced for distribution to district constituents and other interested parties. A minimum of ten articles will appear each year discussing methods to conserve and preserve the quantity of usable quality groundwater within the district.

Performance Standards

8.1a Document in the annual report the number and scope of conservation articles published in the district newsletter.

Management Objective 8.2 Provide news releases to print and electronic media within the district

Each year, not less than 20 news releases discussing methods to conserve and preserve the quantity of usable quality groundwater will be prepared and distributed to print and electronic media within the district.

Performance Standard

8.2a Document in the annual report the number of news releases prepared and distributed to local and regional media detailing methods to conserve and preserve the quantity of usable quality groundwater.

Management Objective 8.3 Produce radio public service announcements and distribute them to stations located within the district

Each year, a series of 60-second pre-recorded radio public service announcements discussing methods to conserve and preserve the quantity of usable quality groundwater will be produced and distributed to radio stations.

Performance Standard

8.3a Document in the annual report a summary of the series of public service announcements produced, distributed, and aired on local radio stations.

Management Objective 8.4 Produce TV public service announcements

Each year, a series of 30-second pre-recorded TV public service announcements discussing methods to conserve and preserve the quantity of usable quality groundwater will be produced and distributed to regional television stations.

Performance Standard

8.4a Document in the annual report the number and a summary of the series of public service announcements produced and distributed to regional television stations.

Management Objective 8.5 Make public presentations on water conservation and the HPWD.

Each year, staff will present a minimum of 15 programs addressing conservation and preservation of usable quality groundwater in the district.

Performance Standard

8.5a Document in the annual report the number of public presentations that were given by staff.

Management Objective 8.6 Maintain public information boards at each county office

Each year, staff will make *The Cross Section, Water Management Notes*, rainwater harvesting manuals, technical reports, brochures, and other printed information available to the public in the reception area of each county office.

Performance Standard

8.6a Document in the annual report the locations and the number of publications made available to the public via the information boards.

Management Objective 8.7 Provide public information displays addressing water conservation and management of the Ogallala Aquifer at least 10 times a year.

Informative exhibits about the hydrology of the Ogallala Aquifer, and the conservation/preservation of usable quality groundwater will be displayed at suitable venues within the district no less than ten times a year.

Performance Standard

8.7a Document in the annual report the number and a brief description of the displays placed within the district.

Management Objective 8.8 Annually sponsor and make presentations to at least twelve classroom education programs related to the Ogallala Aquifer, water conservation, and water quality protection program.

The district will continue to sponsor the *WaterWise, or equivalent* water conservation education program, in public and/or private schools within the district. Also, upon request by teachers, staff will visit area classrooms to present information about groundwater quality, quantity, and water conservation.

Performance Standard

8.8a Document in the annual report the number, names, locations, and feedback from schools receiving educational materials, and the number of classroom presentations made.

Management Objective 8.9 Participate and support the TWDB Ogallala Aquifer Recharge Study

Surface water collected in the thousands of playa lakes on the Southern High Plains is the primary source of recharge to the Ogallala Aquifer. During the 81st Texas Legislature, funding was provided to the Texas Water Development Board to conduct long term, scientific research on potential mechanisms to enhance recharge to the Ogallala Aquifer

While the nature and scope of the Ogallala Aquifer Recharge Study is still very early in its development, the district clearly recognizes the importance of studies such as this with respect to enhancing the economic sustainability of this precious natural resource. Therefore, it is the objective of the district to have an active role throughout the conduct of all aspects of the Ogallala Aquifer Recharge Study.

Performance Standards

8.9a Document in the annual report the progress made over the preceding year on the Ogallala Aquifer Recharge Study.

8.9b Publish a progress report on the Ogallala Aquifer Recharge Study in the district newsletter at least once a year.

Goal 9: Achieve the desired future conditions of the groundwater resources within its jurisdiction

Neither statute nor Texas Water Development Board rules address how this goal is to be articulated prior to the initial adoption of desired future conditions by groundwater management areas **and** receipt of estimates of managed available groundwater by individual groundwater conservation districts. Although the district, through its participation in Groundwater Management Area 1, has adopted a desired future condition of 50 percent of the saturated thickness of the Ogallala Aquifer in place today remaining in the aquifer in 2060, to date, the district has not received estimates of managed available groundwater from the TWDB. Districts in Groundwater Management Area 2 are working to adopt desired future conditions for aquifers in this area. Therefore, in the absence of adopted desired future conditions and receipt of managed available groundwater estimates from the Texas Water Development Board, the district, for now, is not including a goal, objectives, or standards applicable to this requirement. It is the intent of the board to begin the process of revising this management plan as necessary in order to integrate the desired future conditions of the groundwater resources within its jurisdiction as soon as the desired future conditions are adopted.

3.0 Historical Use and Future Demand for Water

One of the foundational activities in the development of a water resources management plan is the analysis and development of projections of demands for water supply in the future (for a defined period of time). In Texas, these demand projections are developed on a decadal basis. In order to develop projections for how much water supply we will need in the future, three questions must be answered: (1) how much water has been used in the recent past, (2) how many people will there be in the future (population projections), and (3) how much water will be required to meet the needs of the projected population in the future. This analysis to develop water demand projections is primarily conducted in Texas as part of the regional water supply planning process (created by the Texas Legislature through the passage of Senate Bill 1 in 1997). Water demand projections are developed for the following water user categories; municipal, rural (county-other), irrigation, livestock, manufacturing, mining, and steam-electric power generation.

Estimates of historical water use, especially estimates from recent times, are very important during the process of developing water demand projections. This is because changes in the volumes and types of water use, especially on a regional basis, will typically occur relatively slowly. Therefore, if one has a good understanding of recent water use statistics, then the projections of future water demands will be much more reliable. Over the past five years, district-wide estimates of groundwater use for the 15 counties located in whole or in part within the district range from a high of 3,005,248 acre-feet in 2000 to a low of 2,757,490 in 2004 (Table 3.1).

Table 3.1 Historical groundwater use, acre-feet (TWDB Water Uses Survey)

2000	2001	2002	2003	2004
3,005,248	2,866,118	3,018,632	2,822,715	2,757,490

Estimates of surface water use in the district indicate that, at least on a volumetric basis, surface water provides a much smaller portion of the total water portfolio for the region (Table 3.2).

Table 3.2 Historical surface water use, acre-feet (TWDB Water Uses Survey)

2000	2001	2002	2003	2004
79,224	82,518	77,594	82,954	69,468

Water use data is collected in Texas through a variety of parallel efforts including the TWDB Water Use Survey Program, which is designed to annually collect information on municipal and industrial water use. Directed research is conducted, typically on a five-year cycle, to assemble information regarding water use for mining and steam-electric power generation. TWDB staff, working with other state and federal agencies, annually collects information at a county by county scale on water use for irrigated agriculture. Summary data of total water use estimates for the period from 2000 - 2004 for the 15 counties located in whole or in part within the district indicates that total water use, as was the case with groundwater use (Table 3.1), has declined from 3,084,472 acre-feet in 2000 to 2,826,958 acre-feet in 2004, representing a decline of almost 8 percent (Table 3.3).

Table 3.3 Total historical water use, acre-feet (TWDB Water Uses Survey)

2000	2001	2002	2003	2004
3,084,472	2,948,636	3,096,226	2,905,669	2,826,958

Table 3.4 contains summary groundwater use estimates by county for the 15 counties located in whole or in part within the district for the period from 2000 - 2004.

Table 3.4 Historical groundwater use by county, acre feet (TWDB Water Uses Survey)

County	2000	2001	2002	2003	2004
Armstrong	595	402	523	415	391
Bailey	186,063	188,611	171,139	156,012	154,592
Castro	495,303	462,995	501,219	393,744	384,285
Cochran	122,063	117,244	123,287	150,256	139,525
Crosby	84,368	118,131	111,359	110,723	103,304
Deaf Smith	222,973	182,963	190,770	146,595	142,043
Floyd	222,514	164,512	176,441	181,507	161,110
Hale	376,906	348,947	394,936	404,737	364,683
Hockley	157,159	164,727	146,253	168,420	164,371
Lamb	331,505	379,856	384,520	356,919	344,073
Lubbock	249,402	236,815	239,003	210,239	214,612
Lynn	113,756	109,077	95,133	87,386	88,525
Parmer	424,442	371,623	462,901	432,923	473,828
Potter	1,411	1,494	1,689	1,464	1,169
Randall	16,788	18,721	19,459	21,375	20,979
Total	3,005,248	2,866,118	3,018,632	2,822,715	2,757,490

A review of water use by water user group is also very important in the development of water demand projections. For example, the population in a region may have increased significantly over the past decade, whereas water use for irrigated agriculture may have declined over the same period. Therefore water demand projections will need to consider these trends on a water user group basis (Table 3.5).

Table 3.5 Historical water use by user group, acre-feet (TWDB Water Uses Survey)						
Year	**Municipal**	**Mfg**	**Steam Electric**	**Irrigation**	**Mining**	**Livestock**
2000	85,770	9,884	8,375	2,945,040	8,857	26,552
2001	83,805	11,648	19,278	2,794,429	5,896	33,580
2002	83,520	8,576	17,292	2,947,736	6,756	32,351
2003	90,286	15,142	17,961	2,744,613	7,413	30,254
2004	82,943	7,963	18,418	2,680,931	7,379	29,324

Table 3.6 documents projected water demands by county for all counties in the district. For this management plan, projected water demands for counties where only a portion of the county is within the district have been determined on the basis of the proportional area of the county within the district compared to the area of the entire county.

Table 3.6 Projected total water demand by county, acre feet (TWDB, 2007)						
County	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Armstrong	514	504	480	432	384	361
Bailey	182,974	179,809	175,779	171,856	167,998	164,231
Castro	478,154	462,276	445,694	429,773	414,450	399,817
Cochran	118,459	113,812	109,413	105,101	100,941	96,980
Crosby	82,003	78,764	75,661	72,681	69,802	67,036
Deaf Smith	224,277	219,156	213,317	207,673	202,164	196,887
Floyd	22,306	21,500	20,690	19,905	19,128	18,372
Hale	367,443	356,656	345,690	334,956	324,460	314,394
Hockley	151,693	145,249	139,256	133,298	127,732	122,755
Lamb	335,021	323,962	315,185	307,372	300,571	295,043
Lubbock	294,312	283,146	272,984	262,847	253,994	246,611
Lynn	115,095	108,962	103,132	97,611	92,372	87,405
Parmer	423,148	420,744	417,040	413,368	409,700	406,154
Potter	26,488	28,545	30,371	32,425	34,654	36,677
Randall	37,473	39,345	41,012	42,969	45,144	46,895

During the regional water planning process, water demand projections are developed on a decadal basis for seven different water user groups (Table 3.7). Both on a statewide basis and within the district, water demand projections for irrigated agriculture represent the majority of water demands throughout the fifty year planning horizon. District-wide, water demand is projected to decline by approximately 12.6 percent between the years 2010 and 2060. Most of this decline is projected to occur in irrigated agriculture.

Table 3.7 Projected total water demand by user group, acre feet (TWDB, 2007)						
User	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Irrigation	2,655,779	2,564,939	2,477,585	2,393,532	2,312,724	2,235,050
Municipal	120,240	127,008	131,938	136,343	140,931	145,308
Livestock	35,802	43,731	45,636	47,664	49,808	52,086
Steam/Electric	21,884	21,136	24,541	28,684	33,716	39,974
Manufacturing	11,581	12,545	13,330	14,083	14,729	15,771
County-Other	9,402	10,053	10,523	10,796	11,098	11,127
Mining	4,675	3,019	2,147	1,161	488	296

4.0 Groundwater Resources

The principal source of groundwater in the district is the Ogallala Aquifer. The Ogallala Aquifer is present within the Ogallala Formation, which consists of clay, silt, fine-to-course grained sand, gravel, and caliche. The layering of these materials varies within short distances, both vertically and horizontally.

Most of the Ogallala Formation is loosely arranged (unconsolidated), however, near the top and locally within the formation some of the sediments have been cemented by calcium carbonate to form beds of caliche. Because caliche is more resistant to erosion, it forms the “caprock” of the escarpment.

Groundwater in the Ogallala Aquifer is considered to be under water-table conditions. The specific yield of the aquifer averages from 15 to 18 percent. This means that 100 feet of saturated thickness would yield 15 to 18 feet of water. The quality of groundwater in the Ogallala Aquifer is generally fresh.

Research indicates that the almost 20,000 playa basins dotting the landscape of the High Plains of Texas function as the focal points of recharge to the Ogallala Aquifer. The amount of recharge to the Ogallala Aquifer within the district depends on numerous factors, including amount of precipitation, transpiration, evaporation, depth-to-water, and lithology.

The Ogallala Aquifer has been the focus of groundwater scientists and engineers for well over a century. A detailed summary of previous scientific investigations focused on the Ogallala Aquifer is clearly beyond the scope of this management plan. However, for the interested reader, the following references are offered as a some of the more important scientific works that are available: Johnson, 1901, White and others, 1946; Seni, 1980; Knowles and others, 1984; Gutentag and others, 1984; Wood and Osterkamp, 1987; Wood and Sanford, 1995; Scanlon and Goldsmith, 1997; McMahon and others, 2006; and Scanlon and others, 2005 and 2007.

The Edwards-Trinity High Plains Aquifer underlies the Ogallala Aquifer throughout a portion of the district. In some areas of the district, the Edwards-Trinity High Plains and Ogallala aquifers are hydraulically connected. Groundwater in the Edwards-Trinity High Plains Aquifer is generally fresh to slightly saline.

Recharge to the Edwards-Trinity High Plains Aquifer generally occurs directly from the overlying Ogallala Aquifer. Some upward movement of groundwater into the Edwards-Trinity High Plains Aquifer from the underlying Triassic Dockum Formation also may occur (Ashworth and Hopkins, 1995).

The Dockum Aquifer generally underlies the Edwards-Trinity High Plains and Ogallala aquifers throughout the district. The primary water bearing zone in the Dockum Group is the Santa Rosa Formation, which consists of up to 700 feet of sandstone and conglomerate interbedded with layers of siltstone and shale (Ashworth and Hopkins, 1995).

Water quality in the Dockum Aquifer can limit use within the district (Ashworth and Hopkins, 1995). Water quality varies from fresh to saline in the Dockum. In the northern part of the district, the water quality tends to be better than in the southern portion of the district.

Groundwater modeling has been an important tool in understanding groundwater resources in Texas and especially in the Ogallala Aquifer for over 40 years. With the passage of Senate Bill 2 in 2001, the use of groundwater availability models by groundwater conservation districts in the development of management plans and by regional water planning groups in the development of regional water plans has been elevated to an unprecedented level, both in Texas and on a national basis. The district is divided into two groundwater availability models for the Ogallala Aquifer that were developed and are maintained under the direction of the TWDB. Most of the district is located in what is referred to as the Southern Ogallala Groundwater Availability Model, while a small portion of the northern area of the district is located in the Northern Ogallala Groundwater Availability Model. In order to better understand groundwater resources within a groundwater conservation district, statute now requires that estimates of recharge, discharge, and various other aspects of groundwater flow such as cross-formational flow and flow into an out of the district be included in the management plan if a groundwater availability model is available for use. The TWDB, in its role of providing technical assistance to the district, conducted groundwater availability modeling runs for the Ogallala, Dockum, and Edwards-Trinity aquifers. Data for Tables 4.1 through 4.5 was provided in GAM Run 09-06 dated April 15, 2009. Irrigation return flow was accounted for in the model by a direct reduction in agricultural pumping as described in Blandford and other (2003). The model for the northern portion of the Ogallala Aquifer does not include any major springs, lakes, streams, or rivers within the district nor does it consider flow into or out of the Ogallala Aquifer from other formations.

Table 4.1 Estimated annual amount of recharge from precipitation to the district, acre feet	
Aquifer or Confining Unit	**Results**
Northern portion of the Ogallala Aquifer	51
Southern portion of the Ogallala Aquifer	638,494
Edwards and Comanche Peak formations	0
Antlers Sand formation	0
Upper portion of the Dockum Aquifer	0
Lower portion of the Dockum Aquifer	1,029

Table 4.2 Estimated annual volume of water that discharges from the aquifer to springs and any surface water body, acre feet	
Aquifer or Confining Unit	**Results**
Northern portion of the Ogallala Aquifer	0
Southern portion of the Ogallala Aquifer	9,676
Edwards and Comanche Peak formations	559
Antlers Sand formation	275
Upper portion of the Dockum Aquifer	0
Lower portion of the Dockum Aquifer	2,485

Table 4.3 Estimated annual volume of flow into the district within each aquifer in the district, acre feet	
Aquifer or Confining Unit	**Results**
Northern portion of the Ogallala Aquifer	392
Southern portion of the Ogallala Aquifer	18,947
Edwards and Comanche Peak formations	619
Antlers Sand formation	716
Upper portion of the Dockum Aquifer	519
Lower portion of the Dockum Aquifer	8,265

Table 4.4 Estimated annual volume of flow out of the district within each aquifer in the district, acre feet	
Aquifer or Confining Unit	**Results**
Northern portion of the Ogallala Aquifer	845
Southern portion of the Ogallala Aquifer	26,713
Edwards and Comanche Peak formations	819
Antlers Sand formation	818
Upper portion of the Dockum Aquifer	283
Lower portion of the Dockum Aquifer	12,166

Table 4.5 Estimated annual volume of flow between each aquifer in the district, acre feet	
Aquifer or Confining Unit	**Results**
From the northern portion of the Ogallala Aquifer to the underlying unit	n.a.
From the southern portion of the Ogallala Aquifer to the underlying unit	6,548
From the overlying Ogallala Aquifer and Cretaceous shale into Edwards and Comanche Peak formations	6,102
From the overlying Edwards and Comanche Peak formations into Antlers Sand formation	3,146
From overlying units into Antlers Sands formations	3,620
From the upper portion of the Dockum Aquifer to the overlying units	3,194
From the lower to the upper portion of the Dockum Aquifer	1,992
From the overlying units (other than the upper portion of the Dockum Aquifer) to the lower portion of the Dockum Aquifer	7,537

5.0 Surface Water Resources

Surface water resources have supplied a small portion of the total water demands within the district when viewed strictly from a volumetric perspective. However, since the early 1960s, surface water supplies have been a very significant and important component of the High Plains of Texas water supply portfolio utilized to meet municipal and industrial water demands in several communities and cities within the district. In particular, water supplies from Lake Meredith provided by the Canadian River Municipal Water Authority have been vital to meeting municipal water demands over the past 50-year period. However, declining water levels in Lake Meredith have required the Canadian River Municipal Water Authority to diversify its water portfolio by adding significant groundwater supplies from the Ogallala Aquifer in Roberts County, located to the north of the district. In addition, local surface water supplies in the form of surface runoff that collects in the playas throughout the district also serves as an important source of water locally, primarily to meet livestock needs and to supplement irrigation needs.

Locally, surface water supplies form stock tanks and other structures can also be an important source of water supply, especially to meet livestock needs. According to data from the TWDB, projected surface water supplies available to the district range from 44,238 acre-feet per year in 2010 to 45,125 acre-feet per year in 2060 (Table 5.1).

Table 5.1 Projected Surface Water Supplies, acre feet (TWDB, 2007)

2010	2020	2030	2040	2050	2060
44,238	44,607	44,660	44,939	45,164	45,125

In total, four surface water reservoirs located outside the district have or are planned to supply water for municipal and industrial use by towns and cities located within the district. Table 5.2 is a summary of the firm yields on the TWDB Surface Water Resource website.

Table 5.2 Firm yield of reservoirs providing water to municipalities within the district, acre-feet

Source	2010	2020	2030	2040	2050	2060
Lake Meredith	69,750	69,750	69,750	69,750	69,750	69,750
White River Lake	2,431	1,947	1,463	979	495	0
Lake Alan Henry	22,500	22,500	22,500	22,500	22,500	22,500
MacKenzie Reservoir	0	0	0	0	0	0
Total	94,681	94,197	93,713	93,229	92,745	92,250

During the regional water planning process, existing surface water supplies are also evaluated on the basis of reservoir yield when water levels are at conservation pool elevation. Table 5.3 is a summary of this analysis, as reported in the 2006 Llano Estacado Regional Water Plan.

5.3 Water supply of reservoirs when water levels are at conservation elevation, acre-feet

Source	Storage	Yield
Lake Meredith	920,300	76,000
White River Lake	44,897	4,000
Lake Alan Henry	115,937	22,500
MacKenzie Reservoir	45,500	5,200

Lake Meredith is located in the Canadian River Basin north of the district in Potter, Moore, and Hutchison counties. Over the last few decades, climatic conditions, changes in land use, and the potentially the impact of Ute Reservoir, located in the upper Canadian River Basin watershed in New Mexico have negatively impacted the firm yield of the reservoir. According to the 2007 State Water Plan, the firm yield of Lake Meredith has been reduced to 69,750 acre-feet per year. Within the district, Lake Meredith supplies water for municipal and industrial use to Brownfield, Lamesa, Levelland, Lubbock, Plainview, O'Donnell, Slaton and Tahoka.

MacKenzie Reservoir is located in the Red River Basin north of the district in Swisher and Briscoe counties. It has a total storage capacity of 45,500 acre-feet and can supply approximately 5,200 acre-feet of water per year when the reservoir is at conservation pool elevation. MacKenzie Reservoir supplies water to Silverton, Tulia, Floydada, and Lockney. During recent dry conditions, MacKenzie Reservoir was unable to meet its contracted demands.

White River Reservoir is located in the Brazos River Basin in southwest Crosby County. It has a total storage capacity of 44,897 acre-feet and can supply approximately 4,000 acre-feet per year when the reservoir is at conservation pool elevation. White River Reservoir supplies water to Ralls, Spur, Post and Crosbyton. White River Municipal Water District has purchased groundwater rights and has drilled wells to supply water to its customers when surface water levels drop below the level at which water can be removed from the reservoir.

Lake Alan Henry is located in the Brazos River Basin southeast of the district in Kent and Garza counties. It has a total storage capacity of 115,937 acre-feet and has a firm yield of 22,500 acre-feet of water per year. Lake Alan Henry was developed to serve as a future water supply for Lubbock and at present, is only used for recreational purposes.

6.0 Water Supply Plans

The Texas model for water supply planning is divided into two separate processes; regional water planning and state water planning. Since 1997 and the inception of the regional water planning process, it has been the responsibility of the individual regional water planning groups to identify and quantify needs for future water supplies and then to recommend water management strategies and projects to meet those water supply needs. A need for additional water supply occurs when the supplies available to an individual water user group for a specified period of time during the planning horizon are less than the projected demand for water supplies for the same time period under drought conditions. For example, a city may have water supplies from an existing well field that are projected to be equal to 1,000 acre-feet per year in 2020. If the water demands for that city are projected to be 1,100 acre-feet per year in 2020, then the city would have a need for an extra 100 acre-feet of water in 2020. During the regional water planning process, needs for additional water supply are quantified, based on an analysis of both projections of water supply availability versus projections of demand for water supply throughout the 50-year planning horizon (Table 6.1).

One of the more unique characteristics of the Texas model for water supply planning is the final step in the overall process, the recommendation by the planning groups of water management strategies and projects to meet future water supply needs. These recommendations carry very significant weight in law, in that if a water project sponsor will require a surface water permit for the project or financing from the state, then the project must be consistent with the regional and state water plans. There are several different water management strategies and projects recommended in the 2006 Llano Estacado Regional Water Plan. Some of the more significant water management strategies recommended to meet future water supply needs in the district include municipal and agricultural water conservation; brackish groundwater desalination; local groundwater development; purchase from City of Lubbock; City of Lubbock well field; expand Bailey County well field; expand CRMWA well field in Roberts County; reuse; Jim Bertram Lake System (amended to include only Lake 7); North Fork scalping project Lubbock; and the Lake Alan Henry pipeline .

A summary of the volume of water resulting if all water management strategies included in the management plan is presented below (Table 6.2)   It should be noted that even if all of the projects identified in the Llano Estacado Regional Water Plan and the 2007 State Water Plan were to be successfully implemented as planned, there would still be some identified needs for which there is no technically or economically feasible water management strategy that could be implemented, thus there are some significant unmet needs, primarily in irrigated agriculture.

Table 6.1 Water supply needs, acre-feet (TWDB, 2007)

County	2010	2020	2030	2040	2050	2060
Armstrong	0	0	0	0	0	0
Bailey	85,285	92,076	92,835	94,094	94,354	93,597
Castro	146,143	192,522	266,820	357,106	358,866	353,154
Cochran	39,909	39,156	37,571	36,052	77,166	73,140
Crosby	10,888	10,431	10,226	9,804	8,767	8,722
Deaf Smith	168,813	193,978	222,967	253,025	245,379	240,650
Floyd	90,731	106,391	109,207	109,200	105,372	100,285
Hale	20,936	55,962	140,389	207,909	225,835	224,411
Hockley	62,664	74,825	82,557	87,500	83,462	81,286
Lamb	114,256	159,003	202,751	240,887	251,507	254,286
Lubbock	70,563	91,869	104,945	119,462	114,803	112,370
Lynn	550	576	528	471	465	457
Parmer	160,683	331,501	363,206	359,358	355,514	351,794
Potter	0	103	4,309	9,047	14,422	18,220
Randall	0	5	3,674	7,628	11,708	14,634
Total	971,421	1,348,398	1,641,985	1,891,543	1,947,620	1,927,006

Table 6.2 Results of implementing water management strategies						
County	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Armstrong	911	1,150	1,389	1,628	1,867	2,030
Bailey	23,374	21,046	18,936	17,033	15,328	13,799
Castro	57,317	52,510	47,666	42,894	39,412	35,477
Cochran	16,334	15,575	14,015	12,609	11,347	10,214
Crosby	36,966	33,349	30,300	27,350	24,695	22,305
Deaf Smith	57,873	52,386	47,282	42,579	38,368	34,593
Floyd	68,471	61,624	55,872	50,285	45,256	40,731
Hale	56,377	51,255	46,804	42,366	38,585	34,771
Hockley	30,254	27,844	25,444	22,893	20,601	18,734
Lamb	17,411	16,387	14,946	13,828	12,449	11,215
Lubbock	84,888	131,395	125,976	121,164	121,483	117,808
Lynn	18,875	17,187	15,475	13,934	12,546	11,298
Parmer	24,100	22,561	21,168	19,054	17,153	15,455
Potter	1,472	3,071	9,892	18,938	20,794	26,819
Randall	8,143	10,950	18,861	27,182	31,163	37,120
Total	502,766	518,290	494,026	473,737	451,047	432,369

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