CLEAR FORK GROUNDWATER CONSERVATION DISTRICT

DISTRICT MANAGEMENT PLAN

DISTRICT MISSION

The Clear Fork Groundwater Conservation District is committed to establish and protect the water rights of local landowners, and preserve this resource for generations to come.

STATEMENT OF GUIDING PRINCIPLES

The citizens of Fisher County recognize the vital importance of the groundwater to the economy and longevity of the county. Being the predominate water resource; the district recognizes the need to conserve and protect the quantity and the quality of groundwater through prudent and cost effective management. The goals of this plan can be best achieved through guidance from locally elected board members who have an understanding of local conditions as well as technical support from knowledgeable agencies. Management planning should be based upon an awareness of the hydro geologic properties of the specific aquifers within the District as well as quantification of existing and future resource data. This management plan is intended only as a reference tool to provide guidance in the execution of district activities, but should allow flexibility in achieving its goals.

GENERAL DESCRIPTION

The District was created by the citizens of Fisher County through election in November, 2002. Directors are elected with Fisher County Commissioner's precincts, with a director from within each of the four precincts. Additionally, one director is elected as an at-large position from the entire county. The current officers are Ted Posey, Chairman; Watson Moore, Vice-Chairman; Donald C. Gruben, Jr. Secretary-Treasurer. Other Board members include Jeremy Terry, and Jack McCall. The District directors meet bi-monthly and notices are posted at the Fisher County Courthouse.

The Clear Fork Groundwater Conservation District has the same real extent as that of Fisher County, Texas. The county has a diverse economy, with agriculture and industry all represented. Livestock operations include cattle, goats, and hogs. Crops include cotton, sorghum, wheat, hay, pecans, and some fruits and vegetables. One of the major industries is National Gypsum, which began operations in Fisher County in 1935. Oil and gas production have been a part of Fisher County for several decades. Recently Wind Power is being developed as a new energy source within the District. Communities in the county include Busby, Claytonville, Eskota, Hobbs, Longworth, McCaulley, Palava, Roby, Rotan, Royston, and Sylvester. The largest tourist attraction is the diverse hunting opportunities in Fisher County.

GENERAL OVERVIEW OF PLAN IMPLEMENTATION

The District is committed to, and will actively pursue, the groundwater management strategies identified in this groundwater management plan. The management plan will be coordinated with District Rules, policies, and activities in order to effectively manage and regulate the drilling of wells, production of groundwater within the District, protection of recharge features, prevent pollution and waste, the transfer of groundwater out of the District, and encouragement of conservation practices and efficient water use within the District.

The District will treat all citizens equally. Citizens may apply to the District for discretion in enforcement of the rules on grounds of adverse economic effect or unique local conditions. Before granting a waiver to any rule the Board will consider the potential adverse effects that adjacent landowners may experience. The exercise of such discretion by the Board may not be construed as limiting the power of the Board.

The District will seek cooperation of all applicable parties in the implementation of this plan and the management of groundwater supplies within the District. All activities of the District will be in cooperation with the coordinated efforts of the appropriate regional or local water management entity. Finally, the District will coordinate its efforts in conjunction with the state-mandated water plan with respect to water supply needs and demands.

LOCATION AND EXTENT

The Clear Fork Groundwater Conservation District shares a boundary with Fisher County. Fisher County is on U.S. Highway 180 west of Abilene in the Rolling Plains region of central West Texas. The county is bordered on the north by Kent and Stonewall counties, on the east by Jones County, on the south by Nolan County, and on the west by Scurry County. Its center point is 32°45' north latitude and 100°23' west longitude. Roby is the county seat; Rotan, the county's largest town, is 225 miles west of Dallas, 65 miles northwest of Abilene and 125 miles southeast of Lubbock. In addition to U.S. 180 the county's transportation needs are served by State highways 70 and 92.

Soils range from red to brown, with loamy surface layers and clayey or loamy subsoil. Between 51 percent and 60 percent of the land in the county is considered prime farmland. The vegetation, typical of the Rolling Prairies, features medium-height to tall grasses, mesquite, and cacti. Cedar, cottonwood, and pecan trees also grow along streams. Many species of wildflowers bloom in the spring and early summer, including daisies, buttercups, tallow weed, Indian blanket, baby's breath, prairie lace, wild verbena, belladonna, and hollyhock. Texas bluebells thrive in low places.

The climate is subtropical and sub humid, with cool winters and hot summers. Temperatures range in January from an average low of 28° F to an average high of 56°, and in July from 70° to 96°. The average annual rainfall measures twenty-two inches, and the average relative humidity is 73 percent at 6 A.M. and 40 percent at 6 P.M. The average annual snowfall is five inches.

The growing season averages 222 days, with the last freeze in early April and the first freeze in early November. The agricultural economy centers around cattle, livestock products and hunting, but 60 percent of the annual agricultural income is from crops, especially cotton, wheat, sorghum, and hay. Petroleum, natural gas, gypsum, rock, and sand and gravel are also produced in the county. *

*Taken from "FISHER COUNTY." Handbook of Texas Online. <http:www.tshautexas.edu/handbook/online/view/NN/hcn4.html> [Accessed Mon Nov 22 9:35 US/Central 2004.] by Hooper Shelton

TOPOGRAPHY AND DRAINAGE

Fisher County covers 897 square miles of grassy, rolling prairies. The elevation ranges from 1,800 to 2,400 feet. The northern third of the county is drained by the Double Mountain Fork of the Brazos River, and the southern two-thirds is drained by the Clear Fork of the Brazos. *(Source: USDA Natural Resources Conservation Service, Abilene Field Office)*

GROUNDWATER RESOURCES OF CLEAR FORK G.C.D.

The Seymour Formation is the only significant source of groundwater. The formation is present in the north one-third of Fisher County, stretching solid from east to west.
The Seymour Aquifer consists of discontinuous beds of poorly sorted gravel, conglomerate, sand and silty clay deposited during the Quaternary Period by eastward-flowing streams. Sediments are composed of clay, silt, sand, conglomerate, gravel, and some caliche. Individual accumulations vary greatly in thickness, although most of the Seymour is less than 100 feet thick. All material forming the Seymour aquifer are unconsolidated alluvial sediments of non-marine origin deposited on the erosional surface of Permian beds. The Permian formations contain beds of gypsum, anhydrite, halite, dolomite, sandstone and shale. In Fisher County the yields of wells range from less than 30 gal/min to as much as 200 gal/min, depending on saturated thickness, and average about 35 gal/min. The water quality generally is slightly saline with some higher salinity problems.

The Dockum, a minor aquifer, is limited to a small portion of the south west corner of the district. The water is primarily used for livestock and oil-field activity.

The Blaine also underlies the District; however, a groundwater availability model has not been completed at this time.

HISTORICAL WATER USE

The following table represents the annual total water usage for Fisher County and is taken from the TWDB, Water Use Survey, Historical Water Use Database.
Unit: Acre Feet (ACFT) GW = groundwater; SW = surface water

Year	Source	Municipal	Manufacturing	Steam Electric	Irrigation	Mining	Livestock	Total
1974	GW	348	0	0	2,093	1,043	237	3,721
	SW	580	178	0	669	79	703	2,209
	Total	**928**	**178**	**0**	**2,762**	**1,122**	**940**	**5,930**
1980	GW	177	22	0	2,000	0	111	2,310
	SW	699	97	0	880	598	491	2,765
	Total	**876**	**119**	**0**	**2,880**	**598**	**602**	**5,075**
1984	GW	79	197	0	1,824	335	69	2,504
	SW	856	49	0	153	0	623	1,681
	Total	**935**	**246**	**0**	**1,977**	**335**	**692**	**4,185**
1985	GW	80	210	0	2,905	362	85	3,642
	SW	786	66	0	252	0	768	1,872
	Total	**866**	**276**	**0**	**3,157**	**362**	**853**	**5,514**
1986	GW	47	201	0	2,156	342	80	2,826
	SW	778	40	0	969	0	725	2,512
	Total	**825**	**241**	**0**	**3,125**	**342**	**805**	**5,338**
1987	GW	20	112	0	1,409	318	87	1,946
	SW	775	15	0	633	0	786	2,209
	Total	**795**	**127**	**0**	**2,042**	**318**	**873**	**4,155**
1988	GW	123	117	0	2,085	299	89	2,713
	SW	674	14	0	232	0	809	1,729
	Total	**797**	**131**	**0**	**2,317**	**299**	**898**	**4,442**

Year	Source	Municipal	Manufacturing	Steam Electric	Irrigation	Mining	Livestock	Total
1989	GW	143	115	0	2,149	278	89	2,774
	SW	610	12	0	328	0	809	1,759
	Total	**753**	**127**	**0**	**2,477**	**278**	**898**	**4,533**
1990	GW	177	109	0	2,073	278	90	2,727
	SW	548	20	0	518	0	817	1,903
	Total	**725**	**129**	**0**	**2,591**	**278**	**907**	**4,630**
1991	GW	150	130	0	1,333	466	93	2,172
	SW	587	19	0	0	2	833	1,441
	Total	**737**	**149**	**0**	**1,333**	**468**	**926**	**3,613**
1992	GW	88	116	0	666	466	73	1,409
	SW	614	15	0	0	2	655	1,286
	Total	**702**	**131**	**0**	**666**	**468**	**728**	**2,695**
1993	GW	102	148	0	1,453	466	74	2,243
	SW	658	18	0	236	2	668	1,582
	Total	**760**	**166**	**0**	**1,689**	**468**	**742**	**3,825**
1994	GW	102	146	0	1,498	466	73	2,285
	SW	665	18	0	340	4	659	1,686
	Total	**767**	**164**	**0**	**1,838**	**470**	**732**	**3,971**
1995	GW	83	140	0	1,626	466	71	2,386
	SW	616	23	0	265	4	640	1,548
	Total	**699**	**163**	**0**	**1,891**	**470**	**711**	**3,934**
1996	GW	139	144	0	2,030	466	64	2,843
	SW	690	3	0	331	4	578	1,606
	Total	**829**	**147**	**0**	**2,361**	**470**	**642**	**4,449**
1997	GW	133	133	0	2,800	466	60	3,592
	SW	710	1	0	311	4	536	1,562
	Total	**843**	**134**	**0**	**3,111**	**470**	**596**	**5,154**
1998	GW	155	145	0	3,566	466	56	4,388
	SW	707	2	0	0	2	502	1,213
	Total	**862**	**147**	**0**	**3,566**	**468**	**558**	**5,601**
1999	GW	145	151	0	3,612	466	56	4,430
	SW	652	1	0	0	2	507	1,162
	Total	**797**	**152**	**0**	**3,612**	**468**	**563**	**5,592**
2000	GW	135	158	0	2,446	466	58	3,263
	SW	554	0	0	13	2	526	1,095
	Total	**689**	**158**	**0**	**2,459**	**468**	**584**	**4,358**
2001	GW	136	158	0	2,707	464	59	3,524
	SW	499	1	0	27	4	530	1,061
	Total	**635**	**159**	**0**	**2,734**	**468**	**589**	**4,585**
2002	GW	470	158	0	3,139	259	58	4,084
	SW	198	1	0	32	2	519	752
	Total	**668**	**159**	**0**	**3,171**	**261**	**577**	**4,836**
2003	GW	470	158	0	2,664	167	56	3,515
	SW	234	1	0	0	1	501	737
	Total	**704**	**159**	**0**	**2,664**	**168**	**557**	**4,252**
2004	GW	471	158	0	2,844	170	57	3,700
	SW	242	1	0	0	1	511	755
	Total	**713**	**159**	**0**	**2,844**	**171**	**568**	**4,455**

PROJECTED WATER NEEDS

Projected water needs are estimated in the 2007 State Water Planning database. Taken from Volume 3, 2007 State Water Planning Database, 5/12/2009.

Positive values reflect a water surplus; negative values reflect a water need.

RWPG	WUG	County	River Basin	2010	2020	2030	2040	2050	2060
G	Bitter Creek WSC	Fisher	Brazos	10	12	13	14	14	11
G	County Other	Fisher	Brazos	64	68	94	115	125	152
G	Irrigation	Fisher	Brazos	546	551	556	562	567	572
G	Livestock	Fisher	Brazos	0	0	0	0	0	0
G	Manufacturing	Fisher	Brazos	-92	-125	-155	-184	-210	-236
G	Mining	Fisher	Brazos	0	0	0	0	0	0
G	Roby	Fisher	Brazos	118	118	117	117	116	113
G	Rotan	Fisher	Brazos	-75	-90	-1	-14	-22	-33
Total Projected Water Needs (acre-feet per year) =				**-167**	**-215**	**-156**	**-198**	**-232**	**-269**

PROJECTED WATER DEMANDS

Total water demand projected by Water User Group through 2060 taken from Volume 3, 2007 State Water Planning Database, 5/12/2009.

RWPG	Water User Group	County	River Basin	2010	2020	2030	2040	2050	2060
G	Bitter Creek WSC	Fisher	Brazos	117	114	113	111	110	113
G	County Other	Fisher	Brazos	185	181	155	134	124	97
G	Irrigation	Fisher	Brazos	2,386	2,314	2,245	2,178	2,113	2,049
G	Livestock	Fisher	Brazos	585	585	585	585	585	585
G	Manufacturing	Fisher	Brazos	192	225	255	284	310	336
G	Mining	Fisher	Brazos	375	359	354	349	344	337
G	Roby	Fisher	Brazos	76	75	75	74	74	76
G	Rotan	Fisher	Brazos	278	271	249	231	222	203
Total Projected Water Demands (acre-feet per year) =				**4,194**	**4,124**	**4,031**	**3,946**	**3,882**	**3,796**

PROJECTED SURFACE WATER SUPPLIES

There is no surface water within the district, with the exception of a few livestock tanks. Based on reported existing surface water rights holders within Fisher County, a total of 915 acre feet of water are permitted by the TCEQ mainly for irrigation use by landowners within the county. Table is from Volume 3, 2007 State Water Planning Database, 5/12/2009.

RWPG	Water User Group	County	River Basin	Source Name	2010	2020	2030	2040	2050	2060
G	Bitter Creek WSC	Fisher	Brazos	Sweetwater Lake/Reservoir	127	126	126	125	124	124
G	County Other	Fisher	Brazos	Oak Creek Lake/ Reservoir	0	0	0	0	0	0
G	Irrigation	Fisher	Brazos	Brazos River Combined Run-of-River Irrigation	746	745	745	745	744	744
G	Livestock	Fisher	Brazos	Livestock Local Supply	585	585	585	585	585	585
G	Roby	Fisher	Brazos	Brazos River Run-of-River	147	149	154	156	158	163
G	Roby	Fisher	Brazos	Sweetwater Lake/Reservoir	47	44	38	35	32	26
G	Rotan	Fisher	Brazos	Colorado River MWD Lake/Reservoir System	203	181	248	217	200	170
Total Projected Surface Water Supplies (acre-feet per year) =					**1,855**	**1,830**	**1,896**	**1,863**	**1,843**	**1,812**

PROJECTED WATER MANAGEMENT STRATEGIES

Water Management Strategies to meet the projected water demand through 2060 by Water User Group, taken from Volume 3, 2007 State Water Planning Database. 5/12/2009.

WUG	WUG County	River Basin	Water Management Strategy	Source Name	Source County	2010	2020	2030	2040	2050	2060
Manufacturing	Fisher	Brazos	Champion Well Field - Phases 1 & 2	Dockum Aquifer	Mitchell	86	114	137	164	188	212
Manufacturing	Fisher	Brazos	Manufacturing Water Conservation	Conservation	Fisher	6	11	18	20	22	24
Rotan	Fisher	Brazos	Subordination	Colorado River MWD Lake / Reservoir System	Reservoir	75	90	1	14	22	33
Total Projected Water Management Strategies (acre-feet per year) =						**167**	**215**	**156**	**198**	**232**	**269**

MODELING RESULTS

Groundwater Resource measurements and modeling were provided by the Texas Water Development Board on July 24, 2009. The table below represents the findings of Groundwater Availability Model Run 09-017, and represents the estimated average recharge, discharge and transfers for the Seymour and Dockum aquifers. Note: Sub-regional water budgets are not exact, due to the size of model cells and the approach used to extract data from the model.

Aquifer or confining unit	Annual Recharge from Precipitation	Annual Volume of flow Into District	Annual Volume of discharge to Springs, Streams & Rivers	Annual Volume of flow Out of the District	Net annual volume of flow between each aquifer
Seymour	12,402	0	3,173	460	230 (out to Blaine and other Permian Units)
Dockum (lower portion)	2,010	63	266	117	NA (GAM does not consider any units overlying or underlying the lower portion within District)

All values are reported in acre-feet per year rounded to nearest 1 acre-foot.

HOW NATURAL OR ARTIFICIAL RECHARGE OF GROUNDWATER WITHIN THE DISTRICT MIGHT BE INCREASED

Brush Management: The eradication of mesquite and salt cedar from areas of moderate to heavy brush canopy would yield additional groundwater supplies.

POTENTIAL DEMAND AND SUPPLY

Based on current calculations and projections it is obvious that issues will arise when demands exceed supplies. The District will use all regulatory statutes available to encourage the cities of Roby and Rotan, and the Water Supply Corporations in the District to develop conservation plans and additional surface water supplies. The District will also encourage additional water supplies through groundwater conservation education programs at the school and community levels.

MANAGED AVAILABLE GROUNDWATER

The desired future conditions for the Seymour, Dockum and Blaine Aquifers located within the District boundaries and within Groundwater Management Area 6 were adopted on July 22, 2010. However, an estimate of the managed available groundwater (MAG) for these aquifers is not yet available, so the requirement to present MAG data in the groundwater management plan is not applicable at this time. Once MAG estimates become available the District will amend the management plan.

TIME PERIOD FOR THIS PLAN

This plan becomes effective upon the adoption by the Board of Directors of the Clear Fork Groundwater Conservation District and approval by the Texas Water Development Board (TWDB). This plan will remain in effect for a period of five years, or until a revised or amended plan is approved: whichever comes first.

ACTIONS, PROCEDURES, PERFORMANCES AND AVOIDANCE FOR PLAN IMPLEMENTATION

The District will implement the provisions of the plan and will utilize the provisions of the plan as a guidepost for determining the direction or priority for all District Activities. All operations of the District, all agreements entered into by the District, and any additional planning efforts in which the District may participate will be consistent with the provisions of the plan.

The District will adopt, as necessary, rules relating to the implementation of this plan. The rules adopted by the District shall be pursuant to TWC §36 and the provisions of this plan. All rules will be adhered and enforced. The promulgation and enforcement of the rules will be based upon the best technical evidence available.

The District shall treat all citizens with equality. Citizens may apply to the District for discretion in enforcement of the rules on grounds of adverse economic effect or unique local characteristics. In granting discretion to any rule, the Board shall consider the potential for adverse effect on adjacent landowners and aquifer conditions. The exercise of said discretions by the Board shall not be construed as limiting the power of the board.

MANAGEMENT GOALS, OBJECTIVES AND PERFORMANCE STANDARDS

- GOAL 1.0 – Providing for the most efficient use of groundwater
  - Management Objective : The District will present annually educational information relating to conservation practices for the efficient use of water resources. These will include but are not limited to publications from the Texas Water Development Board, the Texas Commission on Environmental Quality, Texas Cooperative Extension Service, the Texas Water Resource Institute, and other resources.
  - Performance Standard : A District official will meet with Soil and Water Conservation District Board on a monthly basis. A District official will also offer presentations & publications annually to the local civic organizations, such as Lions Clubs and the Fisher County Agri Day. The District officials will present annually educational information to the students of Fisher County. Documentation of all information disseminated will be in the Annual Report.
- GOAL 2.0 – Controlling and preventing waste of groundwater
  - Management Objective – Document reports of wasted groundwater. The District will collect and will document each report of possibly-wasted groundwater.
  - Performance Standard – The District will investigate 100 percent of the reports to determine if any waste is occurring, and will take action to stop real waste. The Board of Directors will receive a report at each regular meeting that includes the number of wasted groundwater reports made to the District and the number of investigations. Additionally, the report will include the District's recommendations on how to address and how to end 100 percent of the wasteful practices.
- GOAL 3.0 – Addressing Drought Conditions
  - Management Objective – The District will monitor the Palmer Drought Severity Index (PDSI) by Texas Climatic Division. If PDSI indicates that the District will experience severe drought conditions, the District will notify all public water suppliers within the District
  - Performance Standard – The District staff will monitor the PDSI and report findings and actions to the District Board at each regular meeting. The reports and information will be included in the District Annual Report.
- GOAL 4.0 – Addressing Conservation
  - Management Objective - The district will submit an article regarding water conservation for publication each year to at least one newspaper of general circulation in Fisher County.
  - Performance Standard – A copy of the article submitted by the District for publication will be included in the annual report given to the Board of Directors.

- GOAL 5.0 – Addressing Brush control.

    - Management Objective – The District will encourage brush control and Best Management practices related to the same where appropriate.

    - Performance Standard – The District will have an agenda item in at least one open meeting to discuss Brush Control. A District official will meet annually with the Soil and Water Conservation District /Natural Resources Conservation Service Agencies to discuss and support the need for brush control in the district. The reports and information will be included in the District Annual Report.

- GOAL 6.0 – Monitoring Desired Future Conditions of the Groundwater Resources of the District

    - Management Objective – The District will annually measure the water levels of at least two (2) monitoring wells within each aquifer within the District and will monitor the status of the Desired Future Conditions, based on the water level measurements.

    - Performance Standard – The status of the water levels measured and tracking will be included each year in the Annual Report.

MANAGEMENT GOALS DETERMINED NOT-APPLICABLE

- GOAL 7.0 – Control and prevention of subsidence

The District has determined that this goal is not applicable to the operations of the District at this time.

- GOAL 8.0 – Addressing Conjunctive surface water management issues.

No surface water management entities exist within the District. There are no surface water impoundments within the District except for livestock consumption. The groundwater within the district is used primarily for livestock, domestic and irrigated agriculture. The District has determined that this goal is not applicable to the operations of the District at this time.

- GOAL 9.0 – Addressing natural resource issues which impact the use and availability of groundwater, and which are impacted by the use of groundwater.

The District has no documented occurrences of endangered or threatened species dependent upon groundwater resources. The District has determined that this goal is not applicable to the operations of the District at this time.

- GOAL 10.0 – Recharge enhancement.

The District has determined that this goal is not applicable to the operations of the District at this time because it is not cost effective or appropriate at this time.

- GOAL 11.0 – Rainwater harvesting.

The District has determined that this goal is not applicable to the operations of the District at this time because it is not cost effective or appropriate at this time.

- GOAL 12.0 – Precipitation enhancement.

The District has determined that this goal is not applicable to the operations of the District at this time because it is not cost effective or appropriate at this time.

MANAGEMENT OF GROUNDWATER SUPPLY

The District will manage the supply of groundwater within the District in order to conserve the resource while seeking to maintain the economic viability of all resource user groups, public and private. In consideration of the economic and cultural activities occurring within the District, the District will continue to identify and engage in such activities and practices, that if implemented, would result in the conservation and protection of the groundwater. The observation and monitoring network will continue to be reviewed and maintained in order to monitor changing conditions of groundwater within the District. The District will undertake investigations of the groundwater resources within the District and will make the results of those investigations available to the public.

In order to meet its mission, the District may adopt, as necessary, rules to regulate the groundwater withdrawals by means of spacing and/or production limits. The relevant factors to be considered in making the determination to grant a permit or limit groundwater withdrawal will include:

1. The purpose of the District and its rules;
2. The equitable conservation and preservation of the resource, and;
3. The economic hardship resulting from granting or denying a permit or the terms prescribed by the rules.

In pursuit of the District mission of conserving and protecting the resource, the District will enforce the terms and conditions of permits and rules of the District by enjoining the permit holder in a court of competent jurisdiction, as provided for in TWC §36.102, if necessary.

TRACKING DISTRICT PROGRESS IN ACHIEVING MANAGEMENT GOALS

The General Manager will prepare and present an annual report on District performance in regards to achieving management goals and objectives. The report will enumerate the activities which have occurred during previous months. Evidence will be provided in the form of newspaper clippings, reports, programs, photographs, charts, statistical data, dated memos and letters. Evidence will be cross-referenced to the appropriate performance standard and its management objective in order to evaluate the effectiveness and efficiency of the District's operations and to be sure all goals and objectives are being addressed.

The General Manager will report to the directors at the regular scheduled board meetings and will include information and progress of the District. The Annual Report will be completed by November 5 each year and presented to the board of directors at the next regular scheduled board meeting. The report will be on file for public inspection at the District's offices upon adoption.

Attached: GAM Run 09-017

GAM Run 09-017

by Mr. Wade Oliver
Texas Water Development Board
Groundwater Availability Modeling Section
(512) 463-3132 July 24, 2009

EXECUTIVE SUMMARY:

Texas Water Code, Section 36.1071, Subsection (h), states that, in developing its groundwater management plan, a groundwater conservation district shall use groundwater availability modeling information provided by the Executive Administrator of the Texas Water Development Board in conjunction with any available site-specific information provided by the district for review and comment to the Executive Administrator. Information derived from groundwater availability models that shall be included in the groundwater management plan includes:

(1) the annual amount of recharge from precipitation to the groundwater resources within the district, if any;
(2) for each aquifer within the district, the annual volume of water that discharges from the aquifer to springs and any surface water bodies, including lakes, streams, and rivers; and
(3) the annual volume of flow into and out of the district within each aquifer and between aquifers in the district.

The purpose of this model run is to provide information to Clear Fork Groundwater Conservation District for its groundwater management plan. The groundwater management plan for Clear Fork Groundwater Conservation District is due for approval by the Executive Administrator of the Texas Water Development Board before July 6, 2010.

This report discusses the methods, assumptions, and results from model runs using the groundwater availability models for the Seymour and Dockum aquifers. Table 1 summarizes the groundwater availability model data required by statute for Clear Fork Groundwater Conservation District's groundwater management plan. Figure 1 shows the area of the model from which the values in Table 1 were extracted.

The Blaine Aquifer also underlies Clear Fork Groundwater Conservation District; however, a groundwater availability model for the portion of this aquifer within the district has not been completed at this time. If the district would like information for the Blaine Aquifer, they may request it from the Groundwater Technical Assistance Section of the Texas Water Development Board.

METHODS:

We ran the groundwater availability models for the Seymour and Dockum aquifers and (1) extracted water budgets for each year from 1980 through 1997 (Dockum Aquifer) or 1999 (Seymour Aquifer) and (2) averaged the annual water budget values for recharge, surface water outflow, inflow to the district, outflow from the district, net inter-aquifer flow (upper), and net inter-aquifer flow (lower) for the portions of the aquifers located within the district.

PARAMETERS AND ASSUMPTIONS:

Groundwater Availability Model for the Seymour Aquifer

- ☐ We used Version 1.01 of the groundwater availability model for the Seymour and Blaine aquifers. See Ewing and others (2004) for assumptions and limitations of the groundwater availability model for the Seymour and Blaine aquifers.

- ☐ The groundwater availability model includes two layers, representing the Seymour Aquifer (Layer 1) and the Blaine Aquifer and other Permian sediments (Layer 2). Due to a change in the boundary of the Blaine Aquifer subsequent to model development, a groundwater availability model for the portion of the Blaine Aquifer within the district is not available at this time.

- ☐ The root mean square error (a measure of the difference between simulated and actual water levels during model calibration) of the entire model for the period of 1990 to 1999 ranges from 19.6 feet (Seymour Aquifer) to 26.4 feet (Blaine Aquifer and other Permian sediments), representing one percent and three percent of the range of measured water levels respectively (Ewing and others, 2004).

- ☐ All stress periods of the groundwater availability model for the Seymour and Blaine aquifers are monthly. The current model run for 1980 through 1999, therefore, consists of 240 individual stress periods.

- ☐ We used Processing Modflow for Windows (PMWIN) version 5.3 (Chiang and Kinzelbach, 2001) as the interface to process model output.

Groundwater Availability Model for the Dockum Aquifer

- ☐ We used version 1.01 of the groundwater availability model for the Dockum Aquifer. See Ewing and others (2008) for assumptions and limitations of the groundwater availability model.

- ☐ The model includes three layers representing: geologic units overlying the Dockum Aquifer including the Ogallala, Edwards-Trinity (High Plains), Edwards-Trinity (Plateau), Pecos Valley, and Rita Blanca aquifers (Layer 1), the upper portion of the Dockum Aquifer (Layer 2), and the lower portion of the Dockum Aquifer (Layer 3).

- ☐ The aquifers represented in Layer 1 of the groundwater availability model are only included in the model for the purpose of more accurately representing flow between these units and the Dockum Aquifer. This model is not intended to explicitly simulate flow in these overlying units (Ewing and others, 2008).

- ☐ The aquifers represented in Layer 1 and the upper portion of the Dockum Aquifer, represented by Layer 2, are not present within the district. Because of this, no results are presented for these units in Table 1.

- ☐ The mean absolute error (a measure of the difference between simulated and measured water levels during model calibration) in the entire model between 1980 and 1997 is 65.0 feet and 69.6 feet for the upper and lower portions of the Dockum Aquifer, respectively (Ewing and others, 2008). This represents 2.7 and 3.0 percent of the hydraulic head drop across the model area for these same aquifers, respectively.

- ☐ The MODFLOW Drain package was used to simulate both evapotranspiration and springs. However, only the results from model grid cells representing springs were incorporated into the surface water outflow values shown in Table 1.

- ☐ We used Groundwater Vistas version 5.30 Build 10 (Environmental Simulations, Inc., 2007) as the interface to process model output for the groundwater availability model for the Dockum Aquifer.

RESULTS:

A groundwater budget summarizes the water entering and leaving the aquifer according to the groundwater availability model. The model is based on the U.S. Geological Survey's MODFLOW 2000 groundwater modeling code (Harbaugh and others, 2000). Selected components were extracted from the groundwater budget for the aquifers located within the district and averaged over the duration of the calibrated portion of the model run (1980 to 1997 or 1980 to 1999) in the district, as shown in Table 1. The components of the modified budgets shown in Table 1 include:

- ☐ Precipitation recharge—This is the areally distributed recharge sourced from precipitation falling on the outcrop areas of the aquifers (where the aquifer is exposed at land surface) within the district.

- ☐ Surface water outflow—This is the total water exiting the aquifer (outflow) to surface water features such as streams, reservoirs, and drains (springs).

- ☐ Flow into and out of district—This component describes lateral flow within the aquifer between the district and adjacent counties.

- ☐ Flow between aquifers—This describes the vertical flow, or leakage, between aquifers or confining units. This flow is controlled by the relative water levels in each aquifer or confining unit and aquifer properties of each aquifer or confining unit that define the amount of leakage that occurs.

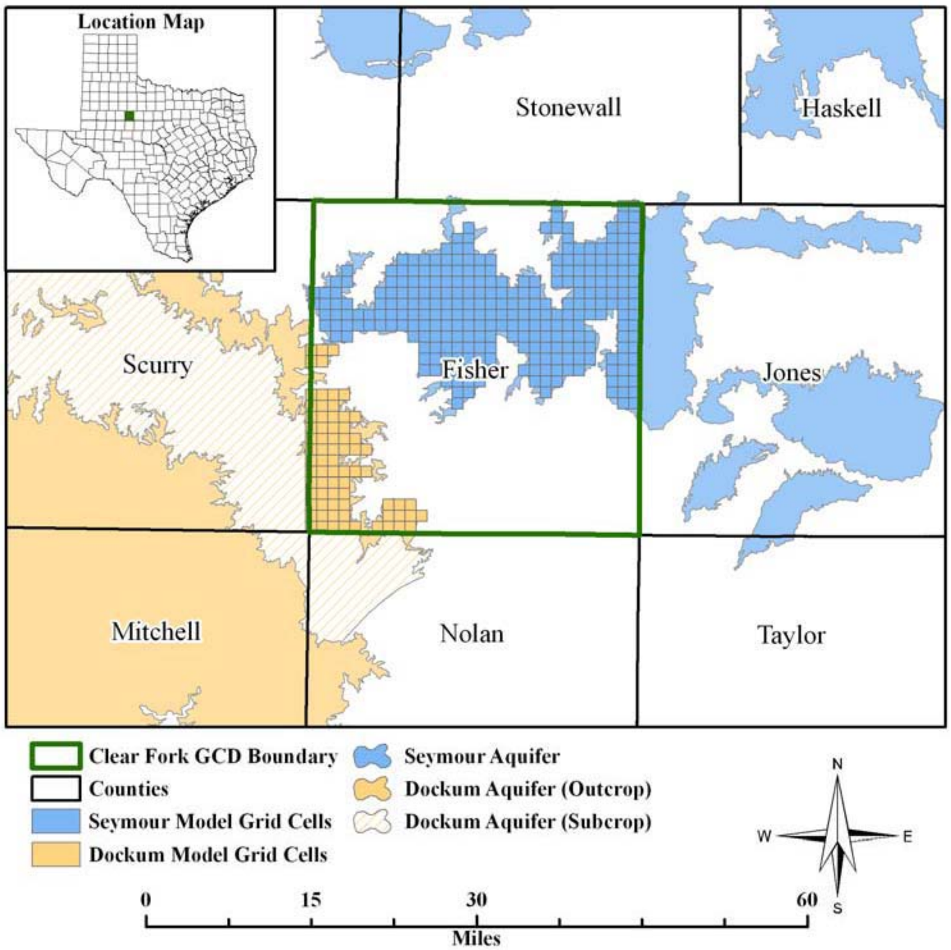
The information needed for the district's management plan is summarized in Table 1. It is important to note that sub-regional water budgets are not exact. This is due to the size of the model cells and the approach used to extract data from the model. To avoid double accounting, a model cell that straddles a political boundary, such as a district or county boundary, is assigned to one side of the boundary based on the location of the model cell's centroid. For example, if a cell contains two counties, the cell is assigned to the county where the centroid of the cell is located.

Table 1: Summarized information needed for Clear Fork Groundwater Conservation District's groundwater management plan[a]. All values are reported in acre-feet per year. All numbers are rounded to the nearest 1 acre-foot.

Management Plan requirement	Aquifer or confining unit	Results[a]
Estimated annual amount of recharge from precipitation to the district	Seymour	12,402
	Lower portion of the Dockum Aquifer	2,010
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Seymour	3,173
	Lower portion of the Dockum Aquifer	266
Estimated annual volume of flow into the district within each aquifer in the district	Seymour	0
	Lower portion of the Dockum Aquifer	63
Estimated annual volume of flow out of the district within each aquifer in the district	Seymour	460
	Lower portion of the Dockum Aquifer	117
Estimated net annual volume of flow between each aquifer in the district	From the Seymour to the Blaine and other Permian Units	230
	Between overlying units and the lower portion of the Dockum Aquifer	NA[b]

[a] A mass balance error of one percent or less is normally considered acceptable for water budgets extracted from numerical flow models (Anderson and Woessner, 1992); however, the water budgets for some stress periods of the groundwater availability model for the Seymour and Blaine aquifers exceeded one percent. After investigating the cause and several alternative approaches to defining the water budget it was determined that, after averaging all 240 stress periods together, the results are reasonable and appropriate for the purposes of the district's management plan.

[b] NA—Not Applicable: The groundwater availability model for the Dockum Aquifer does not consider any units overlying or underlying the lower portion of the Dockum Aquifer within the



district.

Figure 1: Area of the groundwater availability models from which the information in Table 1 was extracted. Note that model grid cells that straddle a political boundary were assigned to one side of the boundary based on the centroid of the model cell as described above.

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Cynthia K. Ridgeway is Manager of the Groundwater Availability Modeling Section and is responsible for oversight of work performed by employees under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G., on July 24, 2009.