LONE WOLF GROUNDWATER CONSERVATION DISTRICT

MANAGEMENT PLAN 2008-2013

Adopted: August 18, 2009

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MISSION STATEMENT

The Mission of the Lone Wolf Groundwater Conservation District is to encourage conservation and the efficient, beneficial use of groundwater through monitoring and protecting the resource while upholding private property rights.

TIME PERIOD FOR THIS PLAN

This plan becomes effective upon approval of the District's Board of Directors and approval by the Texas Water Development Board. The plan remains in effect for five years after the date of approval by the Texas Water Development Board, or until a revised or amended plan is approved.

STATEMENT OF GUIDING PRINCIPLES

The District recognizes that its groundwater resources are of utmost importance to the economy and environment, first to the residents of the District and then to the region. Also recognized is the importance of understanding the aquifers and aquifer characteristics for proper management of these resources. In addition, the integrity and ownership of groundwater play an important role in the management of this precious resource. One of the primary goals of the District is to preserve the integrity of the groundwater in the District from all potential contamination sources. This is accomplished as the District sets objectives to provide for the conservation, preservation, protection, recharge, prevention of waste and pollution, and efficient use of water including:

- Acquiring, understanding and beneficially employing scientific data on the District's aquifers and their hydrogeologic qualities and identifying the extent and location of water supplies within the District, for the purpose of developing sound management procedures;
- Protecting the private property rights of landowners of groundwater by ensuring that such landowners continue to have the opportunity to use the groundwater underlying their land;
- Promulgating rules for permitting and regulation of spacing of wells and transportation of groundwater resources in the District to protect the quantity and quality of the resource;
- Educating the public and managing for the conservation and beneficial use of the water;
- Educating the public and managing the prevention of pollution of groundwater resources;
- Cooperating and coordinating with other groundwater conservation districts with which the District shares aquifer resources.

These objectives are best achieved through guidance from the locally elected board members who understand the local conditions and can manage the resource for the benefit of the citizens of the District and region.

Since a basic understanding of the aquifers and their hydrogeologic properties, as well as a quantification of resources, is the foundation from which to build prudent planning measures, this management plan is intended as a tool to focus the thoughts and actions of those given the responsibility for the execution of District activities.

GENERAL DESCRIPTION OF THE DISTRICT

History

The Lone Wolf Groundwater Conservation District was initially authorized to operate with "temporary" status during the 76th Texas Legislature with the passage of Senate Bill 1911. Subsequent actions of the 77th Texas Legislature removed the temporary status and allowed for the creation of the Lone Wolf Groundwater Conservation District. House Bill 2529 and Senate Bill 2 formally authorized the creation of the District. The voters of Mitchell County approved the District on February 2, 2002.

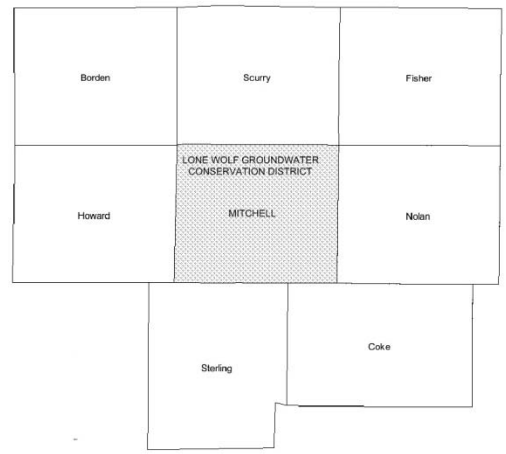

Figure 1. Location of the Lone Wolf Groundwater Conservation District.

Location and Extent

The Lone Wolf Groundwater Conservation District is located in West Texas and consists solely of Mitchell County. The District covers 576,000 acres or 900 square miles. The Colorado River runs through the county giving the county seat it's name of Colorado City.

The County's and District's economy are mainly derived from agriculture and oil production. Cotton and wheat, along with cattle and goat raising make up the majority of the agricultural income. Mitchell County is presently developing wind energy projects, which shall be a future economic staple for the area.

The boundaries of the District follow those of the County. The County is home to approximately 8500 people and consists of three towns: Colorado City, Loraine and Westbrook.

Topography and Drainage

The District lies within the Colorado River Basin and the Great Plains. The topography of the area ranges from flat to rolling hills, but becomes rugged in the south portion of the County, especially in the vicinity of the Colorado River and major creeks. Farms and ranches dominate the area. Drainage from both sides of the county, east and west, flows towards the Colorado River which splits the county in half. Tributaries in the area are intermittent and few springs exist.[1]

[1] Groundwater Availability Model of the Edwards-Trinity (Plateau) and Dockum Aquifer in Weatern Nolan and Eastern Mitchell Counties, Texas. Pg 1.

REGIONAL COOPERATION AND COORDINATION

West Texas Regional Groundwater Alliance

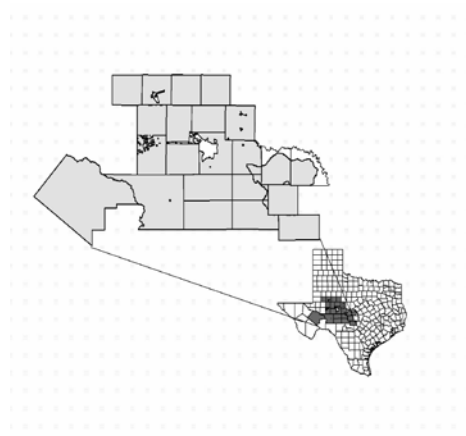

Figure 2. Territory in the West Texas Regional Alliance.

The District is a member of the West Texas Regional Groundwater Alliance (WTRGA). This regional alliance consists of seventeen (17) locally created and locally funded districts that encompass approximately eighteen (18.2) million acres or twenty eight thousand three hundred sixty eight (28,368) square miles of West Texas (Fig 2). To put this in perspective, this area is larger than many individual states including Rhode Island (1,045 sq mi), Delaware (1,954 sq mi), Puerto Rico (3,425 sq mi), Connecticut (4,845 sq mi), Hawaii (6,423 sq mi), New Jersey (7,417 sq mi), Massachusetts (7,840 sq mi), New Hampshire (8,968 sq mi), Vermont (9,250 sq mi), Maryland (9,774 sq mi), and West Virginia (24, 230 sq mi). This West Texas region is as diverse as the State of Texas. Due to the diversity of this region, each member district provides its own unique programs to best serve its constituents.

In May of 1988, four (4) groundwater districts; Coke County UWCD, Glasscock County UWCD, Irion County WCD, and Sterling County UWCD adopted the original Cooperative Agreement. As new districts were created, they too adopted the Cooperative Agreement. In the fall of 1996, the original Cooperative Agreement was redrafted and the West Texas Regional Groundwater Alliance was created. The current member districts and the year they joined the Alliance are:

Coke County UWCD (1988)	Crockett County GCD (1992)	Glasscock GCD (1988)
Hickory UWCD # 1 (1997)	Hill Country UWCD (2005)	Irion County WCD (1988)
Kimble GCD (2004)	Lipan-Kickapoo WCD (1989)	Lone Wolf GCD (2002)
Menard County UWD (2000)	Middle Pecos GCD (2005)	Permian Basin UWCD (2006)
Plateau UWC & SD (1991)	Santa Rita UWCD (1990)	Sterling County UWCD (1988)
Sutton County UWCD (1991)	Wes-Tex GCD (2005)	

This Alliance was created because the local districts have a common objective to facilitate the conservation, preservation, and beneficial use of water and related resources. Local districts monitor the water-related activities of the State's largest industries such as farming & ranching, oil & gas and municipalities. The Alliance provides coordination essential to the activities of these member districts to monitor these activities and to accomplish their objectives.

GROUNDWATER RESOURCES

The data provided for this section of the management plan, unless otherwise noted, is obtained from a study conducted by Arcadis Geraghty and Miller for Mitchell County in October 1998. The study was conducted primarily to determine an alternate resource for the public water supply since the surface water resources were quickly evaporating due to drought. The study consisted of researching and reviewing available information (including published literature, reports, files, data, etc) which contain information pertinent to evaluating the groundwater resources available in the county.

Although the Dockum aquifer underlies more than 40 counties in West Texas, its low water-yielding ability and generally inferior quality results in its categorization as a minor aquifer.

The boundaries of the Lone Wolf Groundwater Conservation District are coextensive with the boundaries of Mitchell County, Texas, covering 583,562 acres. The towns of Colorado City, Loraine and Westbrook are the main population centers in Mitchell County, Texas. The City of Colorado City currently obtains its water supply from water wells located near Loraine with a backup water supply from Lake Colorado City and Lake Champion. Loraine obtains its water supply from water wells located within the city of Loraine. The City of Westbrook purchases its water from Mitchell County Utilities with wells located to the east of Colorado City.

Geology

The geologic rock formations of fresh water-bearing significance in Mitchell County consist of strata of Permian age, the Dockum Group of Triassic age, the Trinity and Fredricksburg Groups of Cretaceous age, the Ogallala Formation of Tertiary age and alluvium of Quaternary age. All of these strata outcrop in Mitchell County. Of paramount importance are the Santa Rosa Formation of the Dockum Group and the sands of the Trinity Group which constitute the principal source of groundwater in the area.[2]

Historically, the uppermost Dockum shale rocks were thought to be correlative with the Chinle Formation found in New Mexico and Arizona. The sandstones below the Chinle were called the Santa Rosa and Trujillo Formations water bearing units and correlated with sandstones found in northeastern New Mexico. The Santa Rosa typically is composed of an upper sandstone unit, a middle shale member, and lower conglomerate sandstone. This division of the Triassic geology has commonly been used in West Texas and was the terminology followed in a report on the groundwater resources in Mitchell County prepared by Victor Shamburger and published by the Texas Water Development Board in June 1967. Although recent studies contest the historic Triassic correlations and nomenclatures and advance proposals for new divisions to the Triassic section found in Mitchell County, the Arcadis G&M report chose to base its findings from the TWDB 1967 report as it is apparent the stated debate will remain ongoing for quite some time.

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[2] Victor M. Shamburger, Jr., Report 50: Groundwater Resources of Mitchell and Nolan Counties, Texas, (Texas Water Development Board, June 1967) Page 12

Permian Strata

Strata of Permian age underlie much of the area but outcrop on the surface in the southeastern part of Mitchell County. The Permian strata consist mainly of red beds which are dense red silt shale with gray-green inclusions interbedded with tight reddish-brown, fine-grained laminated sandstones and occasional gypsum or anhydrite beds. The Permian beds dip westward at a slope of about 25 to 30 feet per mile, steepening considerably in the western part of Mitchell County.

Dockum Group (Santa Rosa and Chinle Foundations)

Strata of the Dockum Group occur on the surface or subsurface in much of Mitchell County. The Dockum Group is generally subdivided into the Santa Rosa Sandstone, the Tecovas Formation, the Trujillo Sandstone and the Cooper Canyon Formation by Lehman. The Cooper Canyon Formation is generally absent in the area except in the extreme western part of Mitchell County. The Cooper Canyon Formation is predominately red clay and shale with thin, ventricular, sandstone interbeds and it overlies the Trujillo Sandstone in the areas where the Cooper Canyon occurs. The Cooper Canyon Formation is generally unimportant as a source of water except for livestock because it yields only small quantities of water which are usually highly mineralized.

The Trujillo Sandstone is a cross-bedded unit composed of sandstones and conglomerates. The base of the unit (top of the Tecovas Formation) is marked by erosional unconformity. The Trujillo may be as much as 100 feet or more in thickness.
The Tecovas shale underlies the Trujillo and is composed of mostly dark gray mudstones and shales. The thickness of the unit may be as much as 45 to 50 feet in some areas.

The Santa Rosa Sandstone occurs beneath the Tecovas and it underlies unconformity on older Permian rocks. It consists of a basal conglomerate overlain by alternating beds of red and gray micaceous shale, clay and sand. The thickness of the formation ranges from a few feet to as much as 45 to 50 feet or more in other areas based on the work done by Lehman and Lucas. The thickness of the entire Dockum Group ranges from a few feet to over 300 feet in the area northeast of Colorado City.[3]

Cretaceous Rocks (Trinity and Fredricksburg Groups)

The Cretaceous rocks which occur in the area are of Lower Cretaceous age and belong to the Trinity and Fredricksburg Groups. These rocks outcrop in southwestern and central Nolan County and underlie Tertiary Ogallala deposits in northwestern Nolan County. Cretaceous rocks are completely absent in Mitchell County, except for the extreme eastern part of the county.

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[3] Victor M. Shamburger, Jr., Report 50: Groundwater Resources of Mitchell and Nolan Counties, Texas, (Texas Water Development Board, June 1967) Page 23

Sands of the Trinity Group consist of moderate to loosely consolidated, white to purplish, fine to medium-grained quartz sand with occasional lenses of quartz gravel at the base of the unit. The thickness of the Trinity sands ranges from 60 to approximately 100 feet. The Trinity sand overlies the Dockum Group (Santa Rosa Formation) in Western Nolan County but it lies directly on Permian strata farther to the east.

The Fredricksburg Group consists of up to 220 feet of calcareous sediments which overlie the Trinity Group in Nolan County. These rocks are of little importance as a source of groundwater in the area.[4]

Tertiary Ogallala Formation

Ogallala sediments of Tertiary age occur in the northwestern part of Nolan County (around Roscoe), the northeastern part of Mitchell County and in west central and northwestern Mitchell County. Near Roscoe, the Ogallala sediments consist of up to 50 feet of caliche, sand and gravel interbedded with light-colored clay. In this area, the Ogallala sediments are generally above the regional water table and are not a source of groundwater. However, they appear to constitute an effective avenue for recharge to the underlying Santa Rosa Formation and Trinity sand.

In the western part of Mitchell County, the Ogallala consists of up to 100 feet of unconsolidated buff-brown sand with a zone of coarse gravel at the base of the formation. In this area, the Ogallala sediments yield small quantities of usable water of variable quality to domestic and livestock wells.[5]

Hydrology

The water-bearing formation of primary interest in Mitchell County is the Santa Rosa Formation which consists of basal gravel and sand of Triassic age overlain by alternating beds of red and gray micaceous shale, clay and sand (which comprises the Tecovas Formation and the Truijillo Sandstone based on Lehman's nomenclature). These strata occur on the surface over most of the county. The Permian rocks only yield small quantities of water to wells and are generally regarded as the base of the fresh water occurrence in the area. In the western part of the county, the Ogallala sediments yield small quantities of usable water of variable quality to domestic and livestock wells. The Permian beds dip westward at an approximate slope of 25 to 30 feet per mile for most of the county, but the dip steepens considerably in the western part of the county.

The literature indicates that the basal gravel and sand of the Santa Rosa Sandstone is highly productive and provides most of the water to wells in the area. In the area north and northeast of Colorado City, the upper part of the Dockum Group (probably the Trujillo Sandstone) is saturated and makes a significant contribution to well yields in the area. However, these upper sands apparently have a different water level than the

[4] Victor M. Shamburger, Jr., Report 50: Groundwater Resources of Mitchell and Nolan Counties, Texas, (Texas Water Development Board, June 1967) Page 24

[5] Victor M. Shamburger, Jr., Report 50: Groundwater Resources of Mitchell and Nolan Counties, Texas, (Texas Water Development Board, June 1967) Page 30

lower Santa Rosa and generally contain water of inferior quality to that found in the basal sand and gravel.

Although the Santa Rosa/Trujillo Aquifer is very productive over most of the area, the literature indicates that the groundwater quality in the aquifer west of the Colorado River is poor and is not suitable for public consumption. In view of this, the remainder of this report focuses primarily on the Santa Rosa/Trujillo Aquifer and the upper productive sands of the Dockum Group in the area east of the river. The thickness of the Dockum Group as a whole in this area may be as much as 300 feet, but the saturated thickness is only approximately 50% or less of the total thickness. Reported yields for water supply wells in this area are up to 1,000 gallons per minute (gpm).

Santa Rosa/Trujillo Aquifer Water Table

Groundwater in the Santa Rosa/Trujillo Aquifer and the overlying rocks of the Dockum Group that are saturated (Trujillo Sandstone) occurs under either slightly artesian conditions or water table conditions. Pumping tests conducted on several wells completed in the Santa Rosa/Trujillo Aquifer and/or the Trujillo Sandstone in the area indicate that, under static condition, the water in the aquifer may be artesian, but with pumping and lowering of the water table below confining strata, water table conditions are produced.

Recharge to the aquifer results from infiltration and percolation of precipitation on the outcrop areas (including the overlying Ogallala and alluvium formations where they occur). The area west of Loraine (where the surface is fairly sandy) is highly conducive to recharge. Significant recharge also occurs along the creeks in the area where alluvium occurs on the surface along the stream channel. The amount of recharge to the Santa Rosa and the Trujillo Sandstone in this area has not been determined. A rough estimate of recharge in this area is approximately 0.5 inches per year which amounts to approximately 26.7 acre-feet per section of land.

The altitude as shown in TWDB maps of the water table in the Santa Rosa/Trujillo Aquifer and or the Trujillo Sandstone for the period of 1960-1961 shows that the direction of groundwater movement in the aquifer was to the west toward the Colorado River where significant discharge to the river occurred. West of the river, the direction of groundwater movement was to the east toward the river.

The static water levels in most (or all) of the Santa Rosa/Trujillo water wells in the area were as high as or higher in the mid-1990s than they were back in the early 1960s. This is reflected by the hydrographs of State observation wells which have historical records spanning the period from the early-1960s to the mid-1990s. Several of the hydrographs show that the water table/piezometric surface in the Santa Rosa/Trujillo Aquifer/Trujillo Sandstone responds quite rapidly and significantly to heavy pumping or cessation in pumping of water wells.

The fact that the water table in this area is at or above the levels in the early 1960s indicates a substantial cessation of groundwater withdrawal from the aquifer for irrigation purposes during that time. The elevation of the water table appears to be approximately 20 feet higher in the mid 1990s than in 1960-61. However due to the sustained drought conditions during the late 1990s, groundwater usage in Mitchell County increased dramatically with irrigation and municipal use. As part of this plan, the District will monitor the groundwater levels regularly to determine the continued effects of increased pumping.

Groundwater Reserves

The gross saturated thickness of the Santa Rosa/Trujillo sediments in the eastern part of Mitchell County range from less than 60 feet in the southern part of the area to over 200 feet in the north. In the areas situated north, northeast and east of Colorado City, the thickness of Santa Rosa/Trujillo sediments ranged from 140 feet to over 200 feet in 1960-61. Accounting for the additional 20 feet in the water table by the mid-1990s, the gross saturation of the aquifer in this area in the mid 1990s ranged from approximately 160 feet to over 220 feet.

An estimate of the amount of groundwater reserves in storage in the aquifer can be made knowing the saturated thickness of Santa Rosa/Trujillo sediments and the effective porosity of the sediments. The effective porosity of the aquifer represents the void space from which water can be drained by gravity expressed as a percentage of the total volume of sediments. No values of the effective porosity for the Santa Rosa/Trujillo Aquifer have been reported in literature. However, based on Arcadis Geraghty and Miller's experience in working with this and other aquifers in West Texas, a conservative value of 10 percent is assumed for the effective porosity of the aquifer. This value was used to estimate the amount of reserves in the aquifer.

Based on the range of gross saturated thickness of the aquifer discussed above for the areas north, northeast and east of Colorado City (160 feet to over 220 feet), the assumed effective porosity of the sediments of 10% and a recovery factor of 70%, the volume of recoverable groundwater presently inplace in the aquifer is estimated to range from approximately 7,168 acre-feet per section to over 9,856 acre-feet per section depending on the location of the property. This represents groundwater reserves present in the aquifer that can be produced by pumping, and it does not include any recharge to the aquifer or exterior drainage from adjoining properties that may be captured once a well field is developed and production begins.

These estimates for groundwater reserves in the aquifer include the apparent poorer quality water that may exist in the upper part of the aquifer which may not be suitable for municipal purposes and may have to be sealed off during construction of water supply wells. The saturated thickness of this upper productive zone is not known with any degree of certainty and would need to be addressed in any subsequent exploratory work to verify the aquifer reserves, quality and productivity.

Groundwater Quality in the Santa Rosa/Trujillo Aquifer

State observation wells completed in the Dockum Group aquifer for which chemical analysis data were available in 1967 and more recent water quality data obtained from the TNRIS are available for a limited number of these observation wells. Data from these observation wells indicate the quality of the groundwater in the Santa Rosa/Trujillo Aquifer is considerably more mineralized in the western part of the county than in the eastern part of the county. Generally speaking, west of the Colorado River the groundwater quality in the aquifer is poor and is unsuitable for municipal purposes. However, east of the river, the water quality in the aquifer is less mineralized and is generally suitable for municipal purposes (with some exceptions). More recent water quality data, where available, confirm this conclusion. For example, State observation well 28-40-608 (located about 10 miles northwest of Colorado City) contained chloride, sulfate and total dissolved solids (TDS) of 560 miligrams per liter (mg/L), 337 mg/L and 1,891 mg/L, respectively, in 1963. In 1986, the chloride, sulfate and TDS concentration in this well were 519 mg/L, 386 mg/L and 1,893 mg/L, respectively. By contrast, State observation well 29-35-702 (located about eight miles east of Colorado City in Loraine) contained chloride, sulfate and TDS of 34 mg/L, 73 mg/L and 418 mg/L, respectively, for these same constituents in 1995. This also indicates that the groundwater quality in this well had not changed appreciably over the indicated time period. In fact, the quality in well 29-35-702 actually improved over the period.

Another important observation concerning the quality of groundwater in the Santa Rosa/Trujillo aquifer is the fact that the quality in the upper sands (Trujillo Sandstone) appears to be inferior to the quality in the deeper basal sands and gravels (Santa Rosa Sandstone). This appears to be true even for wells located east of the Colorado River.

Based on the available chemical quality data, it appears that wells completed in the lower (basal) sands or gravels (the Santa Rosa/Trujillo Aquifer) contain groundwater which would meet the TCEQ standards for municipal water supplies in terms of the chloride, sulfate and TDS content. These standards are 300 mg/L, 300 mg/L and 1,000 mg/L respectively, for these constituents.

The concentrations of nitrate in the groundwater are another important factor in determining the suitability of a water supply for municipal purposes. The MCL for nitrates in public water supplies (as established by the EPA) is 10 mg/L of nitrogen (or 45 mg/L as nitrates). Above this level, adverse health effects can result. The groundwater quality in the Santa Rosa/Trujillo Aquifer in the area east of Colorado City appears to be generally acceptable for municipal purposes from the standpoint of the nitrate content of the water. However, several wells in the area do exhibit elevated nitrate concentrations above the MCL of 45 mg/L. For example, State Well 29-27-902 had nitrates of 81 mg/L in 1978 which increased to 109.9 mg/L in 1986. Well 29-34-515 had nitrate of 66 mg/L in 1963, well 29-34-801 had nitrate levels of 98 in 1946 and well 29-35-108 had nitrate levels of 320 in 1963. No recent nitrates data are available for these wells. The source could be septic systems or areas where nitrate-rich fertilizers are stored. Additional exploration would be necessary to identify and delineate the nature and extent of this problem.

Hydraulic Properties of the Santa Rosa/Trujillo Aquifer and Aquifer Productivity

The results of pumping tests conducted by the Texas Water Development Board in the 1960s on several water wells in the area completed in the Santa Rosa/Trujillo Aquifer were used to estimate the transmissivity and storage coefficient of the aquifer. The transmissivity of the aquifer is defined as the rate at which water flows through a vertical strip of the full saturated thickness of the aquifer one foot wide and under a unit hydraulic gradient. It is a measure of the ability of the aquifer to transmit water. High values indicate greater transmitting capabilities of the aquifer. The storage coefficient is defined as the volume of water released from storage or taken into storage per unit of surface area of the aquifer per unit change in head in the aquifer. For water table aquifers, the storage coefficient is the same as the specific yield (or effective porosity). As discussed earlier, in this area the Santa Rosa/Trujillo Aquifer appears to exhibit slightly artesian conditions under static conditions due to the stratified nature of the aquifer. However, when the aquifer is pumped and the water level lowered below confining strata, water table conditions may be produced. The specific yield (effective porosity) of an aquifer is the volume of water which can be drained by gravity from a unit volume of the aquifer expressed as a fraction or percentage of the unit volume.

The transmissivity values obtained from the pumping tests conducted by the Texas Water Development Board ranged from 5,868 gallons per day (gpd/ft) to 12,300 gpd/ft and averaged 8,845 gpd/ft. Because the tested wells were located over a wide area (east of Colorado City), this range of transmissivity values appears to be representative of the Santa Rosa/Trujillo Aquifer in this area.

The storage coefficient values from the pumping tests ranged from 0.00008 to 0.00044 which are typical of aquifers under artesian conditions. With sustained pumping of the aquifer and lowering of the water table below confining strata, water table conditions are expected to be produced. Storage coefficients (or specific yields) in the range of 0.01 to 0.35 are typical of aquifers under water table conditions.

Reported yields for Santa Rosa/Trujillo water supply wells in the north, northeast and east of Colorado City are up to 1,000 gpm. However, well yields and the productivity of the aquifer will vary across the area and depend on factors such as the lithology of the formation and the gross saturated thickness of the aquifer. The design of the wells also has a significant impact on the yield of the well. Therefore, it would be imperative to conduct exploration and testing to better assess these factors and to determine the productivity of the aquifer and well yields in specific areas of interest.

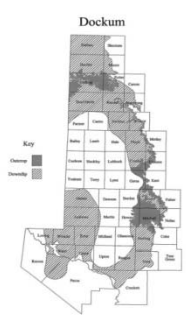


Figure 3. Location of the Dockum Aquifer in the Panhandle and Central West Texas.

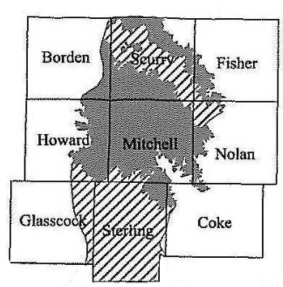


Figure 4. Location of the Dockum Aquifer in and around Mitchell County.

ANNUAL AMOUNT OF ADDITIONAL NATURAL OR ARTIFICAL RECHARGE

Each year, annual precipitation in and around the district results in a recharge of the aquifer of approximately 19,466 acre-feet into the lower Dockum Aquifer. [6] According to GAM Run 08-48 an estimated 1,356 acre-feet flow into the district within the lower Dockum Aquifer while about 433 acre-feet flow out of the district. An additional 194 acre-feet of water flows from upper aquifers into the lower portion of the Dockum.[7] However, more can be done to help the recharge rate.

Brush Control

The Lone Wolf Groundwater Conservation District supports brush control as a management practice to maintain and improve groundwater supplies in the District and region. The District, in fact, wrote a grant for the Mitchell and Nolan Soil and Water Conservation Districts in 2002 for a brush control program along the 41,000 acre Champion Creek Watershed. The $1.3 million grant was funded in the fall of 2002 and to date remains an ongoing program. The District will continue to work with the local SWCD and NRCS offices to support new and ongoing brush control management projects.

The Texas Water Resources Institute, according to the 2001 Region F Water Plan, estimates that one acre-foot of water is lost annually for every 10 acres of brush. Much of the brush consists of mesquite, salt cedar and juniper. As these plants were introduced into the area they spread from the riverbanks to the plains replacing native grasslands. Some of the potential concerns associated with brush are increased erosion, competition for water with grasses, and reduced runoff infiltration. Estimates of the amount of water used by different species of plants in Region F are summarized below.[8]

Recharge Enhancement

Recharge enhancement is the process in which surface water is intentionally directed to areas where permeable soils or fractured rock allow rapid infiltration of the surface water into the subsurface to increase localized groundwater recharge. This includes any man-made structure that would slow down or hold surface water to increase the probability of groundwater recharge.

To determine possible sites for recharge, Region F utilized the geographic information system (GIS) to map the region. Mitchell County is identified as being mostly moderate to some favorable conditions for recharge enhancement. However, topography, drainages, soil properties and the extent and hydraulic characteristics of aquifer outcrops on a local scale would need to be studied before a site could be selected. Consideration should also be given to the potential reduction of surface runoff and how

[6] Table 1, GAM run 08-48, Texas Water Development Board, January 2009
[7] Table 1, GAM run 08-48, Texas Water Development Board, January 2009.
[8] Region F Water Plan (2001) Chapter 5-90

that affects existing surface water reservoirs. Further study is needed to determine the quantity of increased groundwater supplies from enhanced recharge structures and the potential impacts to surface water rights. [9]

Weather Modification to Enhance Yields

Weather modification is defined as an attempt to increase the efficiency of a cloud to return more of the water drawn into the cloud as precipitation. Hail suppression and rainfall enhancement are common forms of weather modification. Early forms of weather modification began in Texas in the 1880s by firing cannons to induce convective cloud formation. Efforts to enhance rainfall in Texas continue to this day. Most efforts to increase rainfall take place in the spring and summer and are halted during the winter months.

A common agent for cloud seeding is Silver iodide, AgI, which is released from flares located on a plane. Silver iodide enhances ice crystal concentrations in clouds, encouraging larger drops to form thereby increasing the likelihood that precipitation will reach the ground. Environmental concerns have been raised with regard to using a heavy metal as a seeding agent, but research conducted along the Oklahoma border indicated only trace amounts, much smaller than allowed by law, of silver in livestock grazing or in soil downwind.

The Colorado River Municipal Water District (CRMWD) began weather modification efforts in 1970. The intent of the rainfall enhancement program is to increase runoff to reservoirs located in the District. The CRMWD has a permit to operate in a 14-county area along the Colorado River, including Mitchell County where the Lone Wolf GCD is located.

The effects of weather modification are difficult to measure. To accurately estimate the benefit of weather modification requires an approximation of how much rainfall would have occurred naturally without weather modification. Research has suggested increases of 15 percent or more of precipitation in areas included in weather modification. Local experiences have shown increases of 27 percent in rainfall. Other methods of measuring the effects of rainfall enhancement, such as dry land farm production, have shown positive benefits of weather modification. Dry land farming has increased in regions participating in rainfall enhancement.[10]

[9] Region F Water Plan (2001) Chapter 5-95
[10] Region F Water Plan (2001) Chapter 5-89

SURFACE WATER RESOURCES

The Lone Wolf Groundwater Conservation District has no jurisdiction over surface water nor does the District have any obligation or the jurisdiction to supply groundwater to surface water permit holders. In addition, only one surface water management entity is located within the boundaries of the District. Two lakes, Lake Colorado City and Champion Creek Reservoir, lay within the boundaries along with an off-channel Mitchell County Reserve. Several other lakes are adjacent to the District and include Lake J.B. Thomas located in Borden and Scurry Counties, Oak Creek Reservoir and E.V. Spencer Reservoir located in Coke County.

Table 1: Water Rights and Diversions of Major Reservoirs[11]

Reservoir	County	Water Right Number	Permitted Storage	Permitted Diversion
			(acre-feet)	(acre feet/yr)
Lake Colorado City	Mitchell	CA-1009	29,934	5,500
Champion Creek Reservoir	Mitchell	CA-1009	40,170	6,750
Mitchell County Reservoir	Mitchell	CA-1008	27,266	43,000*
E.V. Spence Reservoir	Coke	CA-1008	488,760	43,000*
Oak Creek Reservoir	Coke	CA-1031	30,000	10,000
Lake J. B. Thomas	Borden and Scurry	CA-1002	204,000	30,000*

* Total diversions under CA 1002 and CA 1008 limited to 73,000 acre-feet per year. 7,000 ac-ft per year can be diverted at either Thomas or Spence.

Even though there is considerable permitted storage and permitted diversions of surface water, the drought of the 1990s has reduced the amount of water stored in most of these lakes to a small fraction of what they are permitted to store. Lake Colorado City is the only area Reservoir filled to near its capacity. Several years of above average rainfall with above average runoff will be needed to fill the other reservoirs.

It should, however, be mentioned that approximately 6,747 acre-feet of groundwater is discharged each year into springs and surface water bodies including lakes, streams and rivers from the lower Dockum Aquifer within the district. [12]

[11] Table 3.2-1, Major Reservoirs in Region F, State Water Plan 2007.
[12] Table 1, GAM Run 08-48, Texas Water Development Board, January 2009.

PROJECTED SURFACE WATER SUPPLIES

Table 2: Surface Water Rights by Category[13]
Permitted Surface Water Diversions (acre-feet per year)

County	Municipal	Industrial	Irrigation	Mining	Other	Total
Mitchell	2,700	9,550	123	0	0	12,373

Table 2 clearly shows that 12,373 acre-feet of surface water rights have been permitted by the Texas Commission on Environmental Quality. Of the total, 2,700 acre-feet are permitted for municipal use, 123 acre-feet for irrigation, and 9,550 acre-feet for industrial, which is mainly made up of steam-electric. Because there are municipalities and steam-electric production within the boundaries of the district, 123 acre-feet are available for use by the District.

Table 3: 2007 Projected Surface Water Supplies[14]

RWPG	Water User Group	River Basin	Source Name	2000	2010	2020	2030	2040	2050	2060
F	Colorado City	Colorado	Colorado City-Champion Lake/Reservoir System	1,000	0	0	0	0	0	0
F	County Other	Colorado	Colorado City-Champion Lake/Reservoir System	190	0	0	0	0	0	0
F	Steam Electric Power	Colorado	Colorado City-Champion Lake/Reservoir System	3,970	0	0	0	0	0	0
F	Mining	Colorado	Colorado River Run-of-River CRMWD Diverted Water	0	0	0	0	0	0	0
F	Irrigation	Colorado	Colorado River Combined Run-of-River Irrigation	235	15	15	15	15	15	15
F	Livestock	Colorado	Livestock Local Supply	455	381	381	381	381	381	381
Total (acre-feet per year) =				**5,850**	**396**	**396**	**396**	**396**	**396**	**396**

Table 3 shows that surface water use dramatically decreased from 2000 to 2010 and will remain that way for the next forty years.

[13] Table 1.3-3, Surface Water Rights by County and Category, Region F, State Water Plan 2006.
[14] 2007 State Water Plan, Volume 3, Regional Water Planning Group Database.

GROUNDWATER USE

Table 4 indicates more groundwater has been used in the last eight years than ever before. This fact can be attributed to the drought of the late 1990s and early 2000s. During this time, municipalities and utility districts that had relied mostly upon surface water resources were forced to seek alternative water supplies as surface water resources began to dry up. Their only alternative was groundwater.

Table 4: Historical Water Use Summary for Groundwater in Mitchell County, Texas[15]

Unit: Acre Feet (ACFT)

Year	Aquifer	Municipal	Manufacturing	Steam Electric	Irrigation	Mining	Livestock	Total
1980	DOCKUM	223	0	0	3,218	116	50	3,607
	OTHER	2	0	0	0	0	2	4
	Total	**225**	**0**	**0**	**3,218**	**116**	**52**	**3,611**
1984	DOCKUM	152	19	0	2,739	620	42	3,572
	OTHER	2	0	0	0	0	2	4
	Total	**154**	**19**	**0**	**2,739**	**620**	**44**	**3,576**
1985	DOCKUM	174	19	0	4,414	621	32	5,260
	OTHER	1	0	0	0	0	2	3
	Total	**175**	**19**	**0**	**4,414**	**621**	**34**	**5,263**
1986	DOCKUM	182	19	0	2,765	586	38	3,590
	OTHER	1	0	0	0	0	2	3
	Total	**183**	**19**	**0**	**2,765**	**586**	**40**	**3,593**
1987	DOCKUM	117	0	0	2,262	551	36	2,966
	OTHER	1	0	0	0	0	2	3
	Total	**118**	**0**	**0**	**2,262**	**551**	**38**	**2,969**
1988	DOCKUM	139	0	0	2,129	518	39	2,825
	OTHER	1	0	0	0	0	2	3
	Total	**140**	**0**	**0**	**2,129**	**518**	**41**	**2,828**
1989	DOCKUM	136	0	0	1,477	483	38	2,134
	OTHER	2	0	0	0	0	2	4
	Total	**138**	**0**	**0**	**1,477**	**483**	**40**	**2,138**
1990	DOCKUM	131	0	0	1,593	483	38	2,245
	OTHER	2	0	0	0	0	2	4
	Total	**133**	**0**	**0**	**1,593**	**483**	**40**	**2,249**
1991	DOCKUM	122	0	0	2,241	252	39	2,654
	OTHER	2	0	0	0	0	2	4
	Total	**124**	**0**	**0**	**2,241**	**252**	**41**	**2,658**
1992	DOCKUM	177	0	0	953	252	42	1,424
	OTHER	0	0	0	0	0	2	2
	Total	**177**	**0**	**0**	**953**	**252**	**44**	**1,426**
1993	DOCKUM	193	0	0	1,313	244	49	1,799
	OTHER	0	0	0	0	0	2	2
	Total	**193**	**0**	**0**	**1,313**	**244**	**51**	**1,801**
1994	DOCKUM	199	0	0	1,240	244	44	1,727
	OTHER	0	0	0	0	0	2	2

15 Texas Water Development Board, Water Use Survey, Historical Groundwater Pumpage Statistics

	Total	**199**	**0**	**0**	**1,240**	**244**	**46**	**1,729**
1995	DOCKUM	198	0	0	410	141	42	791
	OTHER	0	0	0	0	0	2	2
	Total	**198**	**0**	**0**	**410**	**141**	**44**	**793**
1996	DOCKUM	336	0	0	1,044	141	37	1,558
	OTHER	0	0	0	0	0	2	2
	Total	**336**	**0**	**0**	**1,044**	**141**	**39**	**1,560**
1997	DOCKUM	171	0	0	985	141	39	1,336
	OTHER	0	0	0	0	0	2	2
	Total	**171**	**0**	**0**	**985**	**141**	**41**	**1,338**
1998	DOCKUM	353	0	0	809	141	43	1,346
	OTHER	0	0	0	0	0	2	2
	Total	**353**	**0**	**0**	**809**	**141**	**45**	**1,348**
1999	DOCKUM	418	0	0	2,776	141	41	3,376
	OTHER	0	0	0	0	0	2	2
	Total	**418**	**0**	**0**	**2,776**	**141**	**43**	**3,378**
2000	DOCKUM	1,369	0	0	5,549	141	42	7,101
	OTHER	0	0	0	0	0	2	2
	Total	**1,369**	**0**	**0**	**5,549**	**141**	**44**	**7,103**
2001	DOCKUM	1,254	0	0	3,423	141	40	4,858
	OTHER	0	0	0	0	0	2	2
	Total	**1,254**	**0**	**0**	**3,423**	**141**	**42**	**4,860**
2002	DOCKUM	1,801	0	0	3,670	141	33	5,645
	OTHER	0	0	0	0	0	2	2
	Total	**1,801**	**0**	**0**	**3,670**	**141**	**35**	**5,647**
2003	DOCKUM	1,531	0	0	5,188	141	90	6,950
	OTHER	0	0	0	0	0	5	5
	Total	**1,531**	**0**	**0**	**5,188**	**141**	**95**	**6,955**

PROJECTED DEMANDS FOR WATER

Projected water demands are based on the Region F- 2007 State Water plan combined surface and groundwater demands for the next 50 years.

Table 5: 50-Year Total Water Demand Projections Mitchell County[16]
(Values are in Acre-Feet per Year)

User Group	Historical	Projected					
	2000 Water Demand	2010 Water Demand	2020 Water Demand	2030 Water Demand	2040 Water Demand	2050 Water Demand	2060 Water Demand
Total Municipal	1,728	1,703	1,671	1,621	1,559	1,499	1,409
Total Manufacturing	0	0	0	0	0	0	0
Total Irrigation	5,564	5,534	5,507	5,479	5,452	5,425	5,398
Total Steam Electric	10,280	9,100	7,621	8,910	10,481	12,396	14,730
Total Mining	141	115	110	108	107	106	104
Total Livestock	443	449	449	449	449	449	449
Overall Total	18,156	16,901	15,358	16,567	18,048	19,875	22,090

Table 6: Projected Water Needs
50-Year Comparison of Projected Available Supply
to Projected Demands by Category [17]
(Values in Acre-Feet per Year)

	2010 Water Surpluses/ Needs			2020 Water Surpluses/ Needs			2030 Surpluses/ Needs		
User Group	Supply	Demand	Diff.	Supply	Demand	Diff.	Supply	Demand	Diff.
Total Municipal	1,728	1,703	25	1,718	1,671	47	1,704	1,621	83
Total Irrigation	5,564	5,534	30	5,564	5,507	57	5,564	5,479	85
Total Livestock	449	449	0	449	449	0	449	449	0
Total Mining	141	115	26	141	110	31	141	108	33
Total Steam Electric	0	9,100	-9,100	0	7,621	-7,621	0	8,910	-8,910
Total Manufacturing	0	0	0	0	0	0	0	0	0
Overall Total	**7,882**	**16,901**	**-9,019**	**7,872**	**15,358**	**-7,486**	**7,858**	**16,567**	**-8,709**

[16] 2007 State Water Plan, Volume 3, Region F Water Plan (2006) Table 2.3-4 through 12.
[17] 2007 State Water Plan, Volume 3, Region F Water Plan (2006) Appendix 4A.

Table 6 (cont.): Projected Water Needs
50-Year Comparison of Projected Available Supply
to Projected Demands by Category
(Values in Acre-Feet per Year)

	2040 Water Surpluses/ Needs			2050 Water Surpluses/ Needs			2060 Water Surpluses/ Needs		
User Group	Supply	Demand	Diff.	Supply	Demand	Diff.	Supply	Demand	Diff.
Total Municipal	1,684	1,559	125	1,667	1,499	168	1,639	1,409	230
Total Irrigation	5,564	5,452	112	5,564	5,425	139	5,564	5,398	166
Total Livestock	449	449	0	449	449	0	449	449	0
Total Mining	141	107	34	141	106	35	141	104	37
Total Steam Electric	0	10,481	-10,481	0	12,396	-12,396	0	14,730	-14,730
Total Manufacturing	0	0	0	0	0	0	0	0	0
Overall Total	**7,838**	**18,048**	**-10,210**	**7,821**	**19,875**	**-12,054**	**7,793**	**22,090**	**-14,297**

Based upon supply and demand calculations and future projects, there will be times that the demand for water exceeds the supply. Positive totals indicate a surplus of water available for use while a negative number indicates projected water needs.

It should, however, be pointed out that this only occurs under the category of Total Steam Electric Demand. Currently, the demand of Steam Electric is being fulfilled with a surface water source, Lake Colorado City. Champion Creek Reservoir has also been used in the past to help meet this demand. However, recent drought and demand by the Texas Electric Power Company has brought the supply in the Reservoir to an all time low. If adequate rain was received to fill Champion Creek, the reservoir could once again be instrumental in providing water to TXU.

It is apparent that there is a need to manage the groundwater resource. In order to better manage this resource, better information on the characteristics, recoverable supplies, and recharge of the aquifers will have to be developed.

MANAGEMENT OF GROUNDWATER SUPPLIES

Preservation and protection of groundwater quality and quantity has been the guiding principle of the District since its creation while striving to maintain the economic viability of all groundwater 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 preservation and protection of the groundwater. The District will continue to make regular assessments of groundwater supply and storage conditions and make them available to the public. Additional monitor wells, both water quality and water level, are being added to the well monitor program, along with expansion of programs including the rainfall monitoring program.

The District has adopted rules to regulate groundwater withdrawals by means of spacing regulations and well density (number of wells per section). These rules were amended in April 2008. The District will continue to amend these rules, within the limitations imposed by Chapter 36 of the Texas Water Code, as necessary to regulate groundwater withdrawals by means of additional spacing and/or production limits. District rules also address permitting and registration of wells, waste, well drilling and completion of wells, as well as capping and plugging of unused or abandoned wells. These rules are intended to provide equitable conservation and preservation of the groundwater resources.

The District may deny a drilling permit in accordance with the provisions of the District rules.

The relevant factors to be considered in granting, denying, or limiting a permit include:

1) the purpose of the District rules, including but not limited to, preserving and protecting the quality and quantity of the aquifer resources, and protecting existing uses;
2) the equitable conservation and preservation of the resource; and
3) the economic hardship resulting from denial or limitation of a permit.

In pursuit of the District's mission of preserving and protecting the resource, the District will enforce the terms and conditions of permits and the rules of the District by injunction, mandatory injunction, or other appropriate remedies in a court of competent jurisdiction as provided by Chapter 36.102, Texas Water Code.

The District also recognizes the importance of public education to encourage efficient use, promote conservation, prevent waste, and preserve the integrity of groundwater. District personnel will seek opportunities to educate the public on water conservation issues and other matters relevant to the protection of groundwater resources through public meetings, newspaper articles, newsletters, speaking engagements, and other means that may become available. The District also maintains a website that is updated monthly with relevant information.

By implementing more public education programs specifically aimed at irrigation conservation and additional brush control methods, the District anticipates additional groundwater being available to offset future needs. The following table indicates additional available groundwater for a fifty year period by implementing such programs.

Table 7: Projected Water Management Strategies for Mitchell County (Values in Acre-Feet per Year)[18]

Water Management Strategy	Source Name	Source County	2010	2020	2030	2040	2050	2060
Alternative Generation Technology	Conservation	Mitchell	4,077	2,774	4,240	5,988	8,079	10,590
Subordination	Colorado City-Champion Lake/Reservoir System	Reservoir	5,023	4,847	4,670	4,493	4,317	4,140
Irrigation Conservation	Conservation	Mitchell	0	865	1,729	1,729	1,729	1,729
Brush Control	Colorado City-Champion Lake/Reservoir System	Reservoir	0	0	0	0	0	0
Weather Modification	Weather Modification	Mitchell	0	0	0	0	0	0
Total Projected Water Management Strategies			**9,100**	**8,486**	**10,639**	**12,210**	**14,125**	**16,459**

ESTIMATE OF MANAGED AVAILABLE GROUNDWATER

The Desired Future Conditions for the aquifers located within the District Boundaries and within Groundwater Management Area 7 have not been established; therefore, an estimate of the managed available groundwater is not available at this time. The District is actively working with the other member districts within Groundwater Management Area 7 towards determining the desired future conditions for each aquifer located within the district. Once these are established an estimate of the managed available groundwater will be determined. The District will amend the management plan at that time.

[18] 2007 State Water Plan, Volume 3, Regional Water Planning Group.

ACTIONS, PROCEDURES, PERFORMANCE AND AVOIDANCE FOR PLAN IMPLEMENTATION

The District will implement the provisions of this plan and will utilize the provisions of this plan as a guide for determining the direction and/or priority for District activities. All operations of the District will be consistent with the provisions of this plan.

The District adopted rules in 1999 and amended the rules in 2000, 2001, 2003, 2006, and 2008 and will continue to amend the rules as necessary. Rules adopted or amended by the District shall be pursuant to TWC Chapter 36 and the provisions of this plan. The promulgation and enforcement of the rules will be based on the best scientific and technical evidence available.

The District shall treat all citizens with equality. For good cause, the District, in its discretion and after notice and hearing if required, may grant an exception to the District rules. In doing so, the Board shall consider the potential for adverse effects on adjacent owners and aquifer conditions. The exercise of said discretion by the Board shall not be construed as limiting the power of the Board.

The District maintains a website www.lonewolfgcd.org that is updated monthly. This site contains information on: District activities, forms, rules, board meetings and hearings, agendas, District programs, links to Chapter 36-Texas Water Code, Texas Water Well Drillers and Pump Installers Rules, Rules-Quick Reference Chart for the member districts of the West Texas Regional Groundwater Alliance (WTRGA) and other pertinent information.

Coordination With Surface Water Entities

Several reservoirs are located either in the District, partially in the District, or adjacent to the District. Therefore, in the spirit of cooperation, this management plan has been forwarded for comment to all surface water entities who hold water rights in these reservoirs.

Methodology for Tracking Progress

The methodology that the District will use to track it's progress on an annual basis, in achieving all of its management goals will be as follows:

> The District manager will prepare and present an annual report to the Board of Directors on District performance in regards to achieving management goals and objectives for the previous fiscal year, during the first meeting of each new fiscal year. The report will include the number of instances each activity was engaged in during the year.

The annual report will be maintained on file at the District office.

GOALS, MANAGEMENT OBJECTIVES AND PERFORMANCESTANDARDS

<u>Goal</u>
1.0 Provide for the Efficient Use of Groundwater Within the District. Gather groundwater data both to improve the understanding of the aquifers and their hydrogeologic properties and to quantify this resource for prudent planning and efficient use. (36.1071(a)(1))

<u>Management Objective</u>

1.1 Each year measure, record, and accumulate an historic record of static water levels in at least 20 monitor wells.

<u>Performance Standards</u>

1.1a- District will maintain a water level monitoring network and annually measure the water levels in the well monitor network.

1.1b- Annual report to Board of Directors listing the number of wells measured in the water level monitoring network.

<u>Goal</u>
2.0 Control and Prevent the Waste of Groundwater. Minimize potential contamination of the groundwater by monitoring the drilling and completion of wells. (36.1071(a)(2))

<u>Management Objective</u>

2.1 Each year, register 100 percent of new water wells drilled in the District.

<u>Performance Standards</u>

2.1a- District will maintain files including information on the drilling and completion of all new wells drilled within the District.

2.1b- Annual report to the Board of Directors on the number of new wells drilled during the year.

<u>Goal</u>
3.0 Conjunctive Surface Water Management Issues. (36.1071(a)(4))

<u>Management Objective</u>

3.1 Each year, monitor rainfall events on the watersheds within the District that will impact surface water runoff and groundwater recharge and the results of the year's reporting.

Performance Standards

3.1a- District will maintain a voluntary rainfall monitoring network to monitor rainfall events. Rainfall event data will be filed with the District and used to monitor surface water runoff and groundwater recharge within the District.

3.1b- Annual report to Board of Directors listing the total number of rain gauges in the rainfall monitoring network, the number of rainfall events monitored, and the yearly rainfall data.

Goal
4.0 Drought Conditions. (36.1071(a)(6))

Management Objective

4.1 The District will monitor the Palmer Drought Severity Index by downloading a PDSI map (or Drought Preparedness Situation Report) at least once monthly.

Performance Standards

4.1a- District staff will monitor the Texas Palmer Drought Severity Index and maintain a link to the index on the District website for public access. Additional drought information will be available to the public at the District office. Annual report to Board of Directors listing the number of times drought information was provided to the public.

4.1b- Annual report to Board of Directors listing the number PDSI maps downloaded monthly.

Goal
5.0(a) Conservation. (36.1071(a)(7))

Management Objective

5.1(a) Each year provide and distribute water conservation literature to District residents to promote the efficient use of water.

Performance Standards

5.1(a)1- Water conservation information will be available to the District residents at the District office.

5.1(a)2- Annual report to the Board of Directors listing the number of times water conservation information was distributed to area residents.

MANAGEMENT GOALS DETERMINED NOT-APPLICABLE

Goal
5.0(b) Brush Control. (36.1071(a)(7))

Not appropriate or cost effective. Brush control projects are carried out and funded through the Upper Colorado River Authority and the NRCS. The projects are directed toward replenishing surface water supplies through the increased flow of springs in the creeks and rivers. This management goal is not applicable to the operations of the District.

Goal
5.0(c) Recharge Enhancement. (36.1071(a)(7))

Not appropriate or cost effective. While Mitchell County is shown to have moderate conditions favorable for recharge enhancement, further studies would need to be performed to determine the quantity of increased groundwater supplies from enhanced recharge structures and the potential impacts to surface water rights.

Goal
5.0(d) Rainwater Harvesting. (36.1071(a)(7))

Not appropriate or cost effective. Due to the limited amount of rainfall in the District, it is not cost effective to do large scale rainwater harvesting. This management goal is not applicable to the operations of the District.

Goal
5.0(e) Precipitation Enhancement. (36.1071(a)(7))

Not appropriate or cost effective as a District project. Due to the limited amount of rainfall in the District, it would not be cost effective to participate in a weather modification program. This management goal is not applicable to the operations of the District.

Goal
6.0 Natural Resource Issues. (36.1071(a)(5))

Not appropriate or cost effective. The District has no documented occurrence of endangered or threatened species dependent upon groundwater. Other issues related to resources—air, water, soil, etc. supplied by nature that are useful to life are likewise not documented. The natural resources of the oil and gas industry are regulated by the Railroad Commission of Texas, and are exempt by Chapter 36.117(e). Therefore, this management goal is not applicable to the operations of the District.

<u>Goal</u>
7.0 Control and Prevention of Subsidence. (36.1071(a)(3))

Not appropriate or cost effective. The rigid geologic framework of the region precludes significant subsidence from occurring. This management goal is not applicable to the operations of the District.

<u>Goal</u>
8.0 Desired Future Conditions (DFC's) of the Aquifers. (36.1071(a)(8))

This information is not yet available. GAM runs for the Dockum aquifer have been received from the TWDB, but no DFC has been determined by the District Board of Directors. The District is continuing to evaluate the information from the GAM runs. Additionally, the District continues to work with GMA 7, Region F, other GCDs, the public and the TWDB to establish DFCs for the aquifer prior to the September 1, 2010 deadline. Therefore, since the DFCs of the aquifer within the District have not yet been established, no estimate of the Managed Available Groundwater is available from the Texas Water Development Board.

DEFINITIONS AND CONCEPTS

“Board” - the Board of Directors of the Lone Wolf Groundwater Conservation District.

“DFC” - Desired Future Condition of the aquifer.

“District” - the Lone Wolf Groundwater Conservation District.

“Effective recharge” - the amount of water that enters the aquifer and is available for development.

“Groundwater” - means water percolating below the surface of the earth.

“Integrity” - means the preservation of groundwater quality.

“Natural Resourse Issues” - includes groundwater integrity preservation

“Ownership” - pursuant to TWC Chapter 36, §36.002, means the recognition of the rights of the owners of the land pertaining to groundwater.

“Recharge” - the addition of water to an aquifer.

“Surface Water Entity” - TWC Chapter 15 Entities with authority to store, take, divert, or supply surface water for use within the boundaries of a district.

“TCEQ” - Texas Commission on Environmental Quality.

“TWDB” - Texas Water Development Board.

"Waste" - as defined by Chapter 36 of the Texas Water Code means any one or more of the following:

(1) withdrawal of groundwater from a groundwater reservoir at a rate and in an amount that causes or threatens to cause intrusion into the reservoir of water unsuitable for agricultural, gardening, domestic, or stock raising purposes;

(2) the flowing or producing of wells from a groundwater reservoir if the water produced is not used for a beneficial purpose;

(3) escape of groundwater from a groundwater reservoir to any other reservoir or geologic strata that does not contain groundwater;

(4) pollution or harmful alteration of groundwater in a groundwater reservoir by saltwater or by other deleterious matter admitted from another stratum or from the surface of the ground;

(5) willfully or negligently causing, suffering, or allowing 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 unless such discharge is authorized by permit, rule, or order issued by the Commission under Chapter 26;

(6) 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; or

(7) for water produced from an artesian well, “waste” has the meaning assigned by Section 11.205.

“Well” - means an artificial excavation that is dug or drilled for the purpose of producing groundwater.

ATTACHMENT A

LONE WOLF GROUNDWATERCONSERVATION DISTRICT
P.O. Box 1001
Colorado City, Texas 79512

RESOLUTION
LWGCD MANAGEMENT PLAN
2008 - 2013

WHEREAS, the Lone Wolf Groundwater Conservation District (District) was created by Acts of the 77th Texas Legislature (2001), H.B. 2529 in accordance with Article 16, Section 59 of the Constitution of Texas and Chapters 35 and 36 of the Texas Water Code, as amended; and

WHEREAS, the District is required by SB1 through Chapter 36.1071 of the Texas Water Code to develop and adopt a Management Plan; and

WHEREAS, the District is required by SB1 to submit the adopted Management Plan to the Executive Administrator of the Texas Water Development Board; and

WHEREAS, the District's Management Plan shall be certified by the Executive Administrator once the plan is determined to be administratively complete; and

WHEREAS, the District Board of Directors has determined this Management Plan addresses the requirements of Chapter 36.1071.

NOW, THEREFORE, be it resolved, that the Board of Directors of the Lone Wolf Groundwater Conservation District, following notice and public hearing, hereby adopts this Management Plan; and

BE IT FURTHER RESOLVED, that this Management Plan shall become effective immediately upon adoption by the District.

Adopted this 18th day of August, 2009.

David Stubblefield
Board Chairman

Attest:

Tommy Morris
Secretary-Treasurer

ATTACHMENT B

ATTACHMENT C

GAM Run 08-48

by Mr. Wade Oliver
Texas Water Development Board
Groundwater Availability Modeling Section
(512) 463-3132
January 23, 2009

EXECUTIVE SUMMARY:

Texas State 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 Lone Wolf Groundwater Conservation District for its groundwater management plan. The groundwater management plan for Lone Wolf Groundwater Conservation District is due for approval by the Executive Administrator of the Texas Water Development Board before February 20, 2009.

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

METHODS:

We ran the groundwater availability model for the Dockum Aquifer and (1) extracted water budgets for each year of the 1980 through 1997 period 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 Dockum Aquifer located within the district.

PARAMETERS AND ASSUMPTIONS:

- 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 upper portion of the Dockum Aquifer, represented by Layer 2 of the groundwater availability model, is not present within the district. Because of this, no results are presented for the upper portion of the Dockum Aquifer 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 (Environmental Simulations, Inc., 2007) as the interface to process model output.

RESULTS:

A groundwater budget summarizes the water entering and leaving the aquifer according to the groundwater availability model. 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) 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. "Inflow" to an aquifer from an overlying or underlying aquifer will always equal the "Outflow" from the other aquifer.

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 centroid of the model cell. 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 Lone Wolf Groundwater Conservation District's groundwater management plan. 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
Estimated annual amount of recharge from precipitation to the district	Lower portion of the Dockum Aquifer	19,466
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Lower portion of the Dockum Aquifer	6,747
Estimated annual volume of flow into the district within each aquifer in the district	Lower portion of the Dockum Aquifer	1,356
Estimated annual volume of flow out of the district within each aquifer in the district	Lower portion of the Dockum Aquifer	433
Estimated net annual volume of flow between each aquifer in the district	From overlying units to the lower portion of the Dockum Aquifer	194

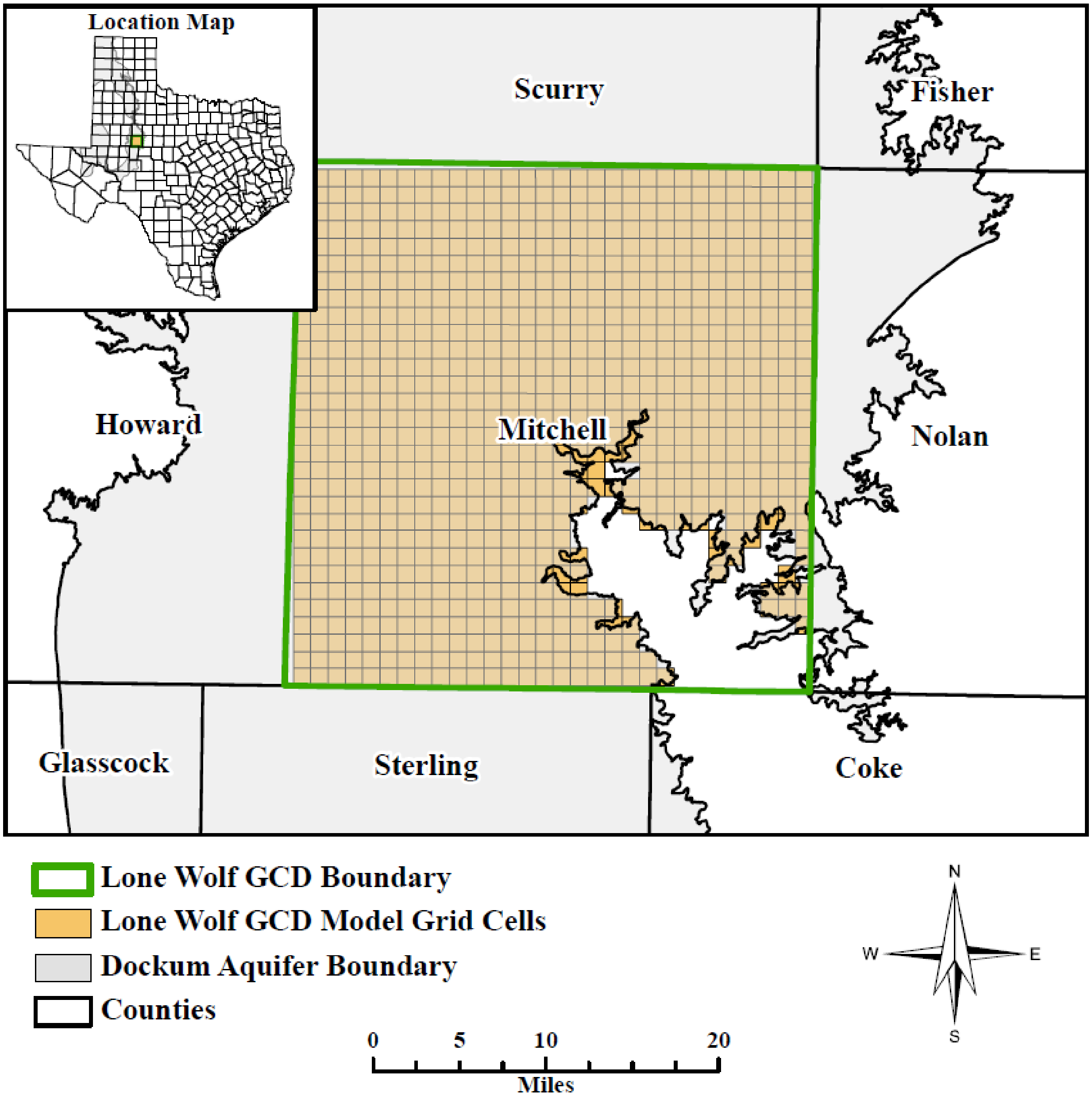
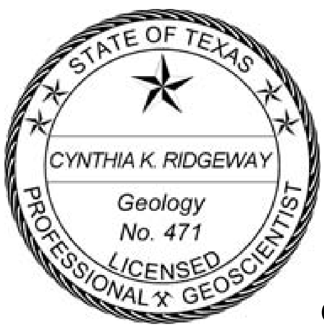


Figure 1: Area of the groundwater availability model for the Dockum Aquifer from which the information in Table 1 was extracted. Note that model grid cells that straddle a political boundary were assigned to one side of the boundary based on the centroid of the model cell as described above.

REFERENCES:

Environmental Simulations, Inc. 2007, Guide to Using Groundwater Vistas Version 5, 381 p.

Ewing, J.E., Jones, T.L., Yan, T., Vreugdenhil, A.M., Fryar, D.G., Pickens, J.F., Gordon, K., Nicot, J.P., Scanlon, B.R., Ashworth, J.B., and Beach, J., 2008, Groundwater Availability Model for the Dockum Aquifer – Final Report: contract report to the Texas Water Development Board, 510 p.



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 January 23, 2009.

ATTACHMENT D

Lone Wolf Groundwater Conservation District

August 18, 2009

Mike Hemphill
Mitchell County Utilities
5345 LCR 256
Colorado City, Texas 79512

Re: Lone Wolf Groundwater Conservation District Management Plan

Dear Mr. Hemphill:

The Lone Wolf Groundwater Conservation District has updated the District Management Plan for 2003 to 2013. The new Management Plan, dated 2008 to 2013, will replace the old Management Plan and brings the District up-to-date with current state laws. Under §36.1072, Texas Water Code, as amended, the District must review and revise its management plan every five years and submit it to the Texas Water Development Board for review and approval.

Under §36.1071, Texas Water Code, as amended, the District is required to coordinate with surface water entities in preparation of its management plan. In compliance with this chapter of the water code, the District is submitting to you a copy of the draft management plan for your review and comments.

Please review this management plan and submit any comments or suggestions to the District by September 18, 2009. If you have any questions or want additional information as you review this plan, please contact the District office at (325) 728-2027. We appreciate your attention and cooperation in reviewing this management plan.

Sincerely,

Sue Young
Sue Young
General Manager

enclosures

P O Box 1001 131 West 5th Street Colorado City, TX 79512
(325) 728-2027 Fax (325) 728-3046

Lone Wolf Groundwater Conservation District

August 18, 2009

Mayor Carol Sue Dakan
City of Colorado City
P.O. Box 912
Colorado City, TX 79512

Re: Lone Wolf GCD Management Plan

Dear Mayor Dakan:

The Lone Wolf Groundwater Conservation District has updated the District Management Plan for 2003 to 2013. The new Management Plan, dated 2008 to 2013, will replace the old Management Plan and brings the District up-to-date with current state laws. Under §36.1072, Texas Water Code, as amended, the District must review and revise its management plan every five years and submit it to the Texas Water Development Board for review and approval.

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Sincerely,

Sue Young

Sue Young
General Manager

enclosures

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(325) 728-2027 Fax (325) 728-3046

Lone Wolf Groundwater Conservation District

August 18, 2009

City of Loraine
P.O. Box 7
Loraine, TX 79532

Re: Lone Wolf Groundwater Conservation District Management Plan

The Lone Wolf Groundwater Conservation District has updated the District Management Plan for 2003 to 2013. The new Management Plan, dated 2008 to 2013, will replace the old Management Plan and brings the District up-to-date with current state laws. Under §36.1072, Texas Water Code, as amended, the District must review and revise its management plan every five years and submit it to the Texas Water Development Board for review and approval.

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Sue Young
General Manager

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P O Box 1001 131 West 5th Street Colorado City, TX 79512
(325) 728-2027 Fax (325) 728-3046

Lone Wolf Groundwater Conservation District

August 18, 2009

City of Westbrook
110 N. Hooper
Westbrook, TX 79565

Re: Lone Wolf Groundwater Conservation District Management Plan

The Lone Wolf Groundwater Conservation District has updated the District Management Plan for 2003 to 2013. The new Management Plan, dated 2008 to 2013, will replace the old Management Plan and brings the District up-to-date with current state laws. Under §36.1072, Texas Water Code, as amended, the District must review and revise its management plan every five years and submit it to the Texas Water Development Board for review and approval.

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Sincerely,

Sue Young

Sue Young
General Manager

enclosures

P O Box 1001 131 West 5th Street Colorado City, TX 79512
(325) 728-2027 Fax (325) 728-3046

Lone Wolf Groundwater Conservation District

August 18, 2009

Westbrook ISD
102 East Bertner
Westbrook, TX 79565

Re: Lone Wolf Groundwater Conservation District Management Plan

The Lone Wolf Groundwater Conservation District has updated the District Management Plan for 2003 to 2013. The new Management Plan, dated 2008 to 2013, will replace the old Management Plan and brings the District up-to-date with current state laws. Under §36.1072, Texas Water Code, as amended, the District must review and revise its management plan every five years and submit it to the Texas Water Development Board for review and approval.

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Sincerely,

Sue Young

Sue Young
General Manager

enclosures

P O Box 1001 131 West 5th Street Colorado City, TX 79512
(325) 728-2027 Fax (325) 728-3046

Lone Wolf Groundwater Conservation District

August 18, 2009

David H. Ham, Water & Waste Water Engineer
Texas Department of Transportation
125 East 11th Street
MNT Division
Austin, Texas 78701-2409

Re: Lone Wolf Groundwater Conservation District Management Plan

Dear Mr. Ham:

The Lone Wolf Groundwater Conservation District has updated the District Management Plan for 2003 to 2013. The new Management Plan, dated 2008 to 2013, will replace the old Management Plan and brings the District up-to-date with current state laws. Under §36.1072, Texas Water Code, as amended, the District must review and revise its management plan every five years and submit it to the Texas Water Development Board for review and approval.

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Sue Young

Sue Young
General Manager

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