

Proposed Desired Future Conditions

District representatives to the GMA-1 Joint Planning Committee from the High Plains Underground Water Conservation District, North Plains Groundwater Conservation District, Hemphill County Underground Water Conservation District, and the Panhandle Groundwater Conservation District in consideration of groundwater availability models, the requirements under Texas Water Code and Texas Administrative Code, previous Groundwater Management Area 1 Joint Planning information, and other data or information for the management area, propose desired future conditions (DFCs) for the aquifers relevant to management area planning as presented in the resolution executed on _____, 2016. A copy of the resolution is attached and located in _____. GMA-1 District representatives propose DFCs based on consideration of distinct aquifer uses and conditions that exist across the management area to achieve a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater. District representatives propose different DFCs for the Dockum, Ogallala and Rita Blanca aquifers because aquifer uses or conditions within the management area differ, including conditions that differ substantially from one geographic area to another. District representatives have thoroughly considered the nine factors detailed in Chapter 36.108(d) of the Texas Water Code over the course of the past five years.

GMA-1 DFCs provide a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater in the management area. The water code does not prohibit the establishment of desired future conditions that provide for the reasonable long-term management of groundwater resources consistent with the goals reflected in the districts' management plans.

In summary, the Districts propose for adoption desired future conditions as follows:

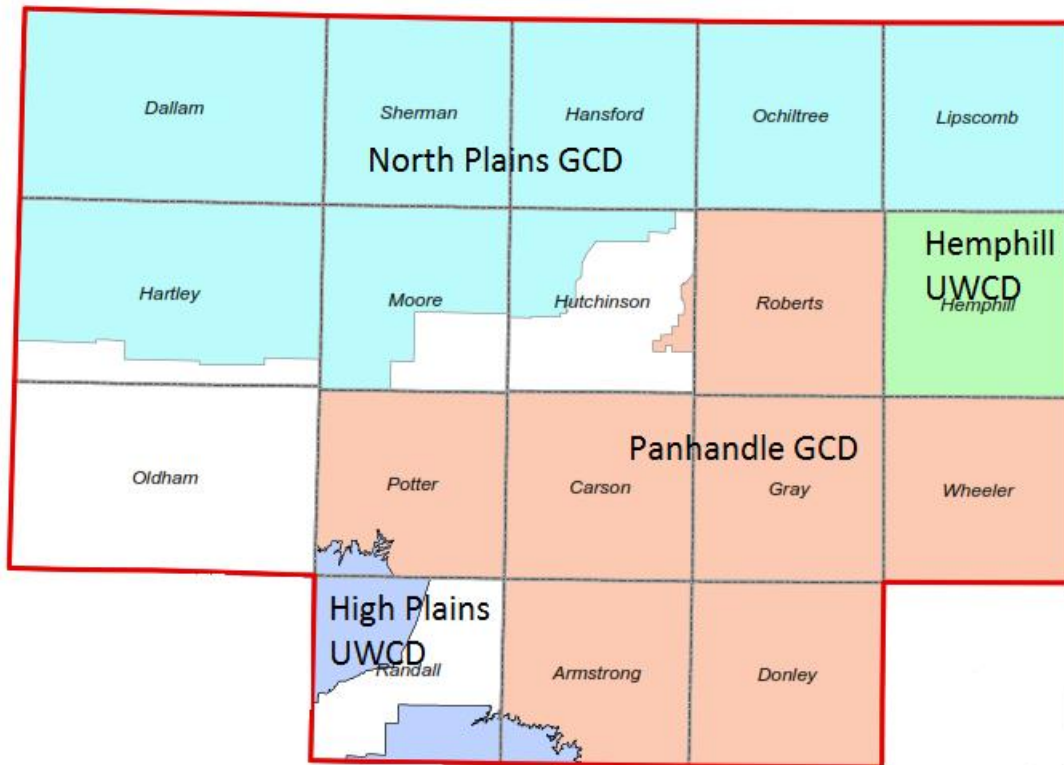
Aquifer	Desired Future Condition Summary
Dockum	40 % of volume in storage remaining in 50 years in Dallam, Hartley, Moore, and Sherman counties. Average decline in water levels will decline no more than 30 feet over the next 50 years in Oldham, Armstrong, Carson, Hutchinson, Oldham, Potter, and Randall Counties.
Ogallala and Rita Blanca	40 % of volume in storage remaining in 50 years in Dallam, Hartley, Moore, and Sherman counties; 50 % of volume remaining in 50 years in Armstrong, Potter, Randall, Hansford, Hutchinson, Lipscomb, Ochiltree, Carson, Donley, Gray, Roberts, Wheeler, and Oldham counties; and 80 % of volume in storage remaining in 50 years in Hemphill County.

Background

On September 1, 2005, the 79th Texas Legislature's House Bill 1763 became law amending Texas Water Code Chapter 36 specifically requiring groundwater conservation district representatives to meet at least annually to conduct joint planning with the other districts in the management areas suitable for the management of groundwater resources and to review the management plans, the accomplishments of the management area, and proposals to adopt new, or amend existing DFCs. Chapter 36 defines "desired future condition" as a quantitative description, adopted in accordance with Section 36.108 (Joint Planning in Management Area), of the desired condition of the groundwater resources in a management area at one or more specified future times. The Texas Water Development Board (TWDB)

provides additional guidance by defining a DFC under Texas Administrative Code, Title 31, Part 10, §356.10 (6) as "the desired, quantified condition of groundwater resources (such as water levels, spring flows, or volumes) within a management area at one or more specified future times as defined by participating groundwater conservation districts within a groundwater management area as part of the joint planning process." This joint planning process regionalizes decisions on groundwater availability by defining groundwater production targets and providing the required groundwater availability data for regional water planning, while also considering regional water planning information in proposing and adopting desired future conditions.

Groundwater Management Area 1 (GMA 1) is one of the sixteen groundwater management areas throughout the state, established by the TWDB for joint planning for the management of groundwater resources. Hemphill Underground Water Conservation District, North Plains Groundwater Conservation District, Panhandle Groundwater Conservation District and part of High Plains Underground Water Conservation District are located in GMA-1 comprising an eighteen county area in the Texas Panhandle. The Chairman of each of these four Groundwater Conservation Districts comprise the voting membership of the GMA-1. The map below shows the district boundaries within GMA-1.



GMA-1 is among the largest water-consuming regions in the State, relying almost exclusively on groundwater as its water source. TWDB Historical Water Use Estimates show that over 98% of the water used within GMA-1 comes from groundwater and is pumped from the Ogallala, Dockum, Rita Blanca, Blaine, and Seymour aquifers. The Ogallala aquifer is the primary groundwater source in all eighteen counties of the management area, with the Dockum aquifer serving as a secondary water source in

eleven counties. The Rita Blanca aquifer is located solely in Dallam and Hartley counties of the North Plains Groundwater Conservation District and is hydraulically connected to the Ogallala aquifer. Because of this hydraulic connection, the voting membership of the GMA-1 unanimously opted to combine the Ogallala and Rita Blanca aquifers during their considerations of DFCs.

Current Desired Future Conditions and Non Relevant Aquifers

The districts in GMA-1 adopted desired future conditions for the Ogallala aquifer in 2009, the Dockum aquifer in 2010 and the Blaine aquifer in 2010. The district representatives reviewed these previously established DFCs throughout the process of considering the second round of DFCs in 2016. On May 30, 2014, the GMA-1 opted to consider the previously adopted and thus current desired future conditions. As the process progressed the body found that the Blaine and Seymour aquifers were not relevant for management area joint planning. The Blaine and Seymour aquifers generally are not hydraulically connected to any other aquifer within the management area, and de minimis portions of these aquifers are located in two separate counties within Panhandle Groundwater Conservation District.

District Representatives Consider Factors

Texas Water Code Chapter 36 requires that every five years, the districts consider groundwater availability models and other data or information for the management area and propose DFCs for adoption for the relevant aquifers within the management area. For the current round of joint planning, the districts must propose the adoption of DFCs for the relevant aquifers within a management area prior to May 1, 2016. In accordance with Texas Water Code Chapter 36.108, the GMA-1 district representatives considered prior to voting on proposed DFCs for the major aquifers in the Joint Planning Area the following nine factors:

- (1) aquifer uses or conditions within the management area, including conditions that differ substantially from one geographic area to another;
- (2) the water supply needs and water management strategies included in the state water plan;
- (3) hydrological conditions, including for each aquifer in the management area the total estimated recoverable storage as provided by the executive administrator, and the average annual recharge, inflows, and discharge;
- (4) other environmental impacts, including impacts on spring flow and other interactions between groundwater and surface water;
- (5) the impact on subsidence;
- (6) socioeconomic impacts reasonably expected to occur;
- (7) the impact on the interests and rights in private property, including ownership and the rights of management area landowners and their lessees and assigns in groundwater as recognized. The legislature recognizes that a landowner owns the groundwater below the surface of the landowner's land as real property.;
- (8) the feasibility of achieving the desired future condition; and
- (9) any other information relevant to the specific desired future conditions.

After considering and documenting each of the factors described above and other relevant scientific and hydrogeological data at multiple meetings respectively, the districts are statutorily allowed to establish different desired future conditions for:

- (1) each aquifer, subdivision of an aquifer, or geologic strata located in whole or in part within the boundaries of the management area; or
- (2) each geographic area overlying an aquifer in whole or in part or subdivision of an aquifer within the boundaries of the management area.

In the following sections, a summary of the extensive analysis conducted by the GMA-1 related to each of the required factors is presented.

Factor 1 Aquifer uses or conditions within the management area, including conditions that differ substantially from one geographic area to another.

Texas Water Code 36.108 (d)(1) requires the districts to consider aquifer uses or conditions within the management area, including conditions that differ substantially from one geographic area to another.
GMA 1

GMA-1 district representatives met on May 30, 2014; August 19, 2014; November 14, 2014; and _____ to review, discuss, and ultimately consider aquifer uses and conditions for the Blaine, Dockum, Ogallala, Rita Blanca and Seymour aquifers within the management area. During those meetings the district representatives addressed aquifer use information provided in part from the following:

- Information compiled during consideration of desired future conditions in 2009 and 2010;
- TWDB Water Use Surveys Historic Summary Estimates by County from 2007-2013. Historical Water Use Estimates are specific to the location where surface and groundwater is used by end users;
- TWDB Historical Groundwater Pumping Estimates for 2000 to 2013. Data reports for 2000 and later are generated directly from the TWDB's Water Use database and reflect the most current and accurate data available to the agency. These estimates are specific to the location where groundwater is withdrawn from an aquifer;
- District reports and presentations regarding aquifer uses or conditions including groundwater withdrawal estimates based on direct and indirect measurements, primary water user groups, groundwater level and saturated thickness conditions.
- The 2011 Panhandle Regional Water Plan adopted by reference in the 2012 Texas State Water Plan and the 2016 Panhandle Regional Water Plan currently in review by the TWDB to be adopted in the 2017 State Water Plan;
- Final Conceptual Model Report for the High Plains Aquifer System Groundwater Availability Model Report (Deeds et. al. 2015) and the accompanying Numerical Model Report for the High Plains Aquifer System Groundwater Availability Model (Deeds et. al. 2015) that were prepared for the TWDB;
- Groundwater Recharge in the Central High Plains of Texas: Roberts and Hemphill Counties (Reedy, Davidson, Crowell, et. al. 2009)

- Reports and presentations provided by principal water users within the management area.

District representatives adopted the “Water User Group” (WUG) definition consistent with the most current state water plan for the purposes of joint planning. A WUG is an identified water user or group of users for which water demands and water supplies have been identified and analyzed and plans developed to meet water needs. Collectively WUGs include: irrigation, municipal and domestic water use, manufacturing, steam electric power generation, mining, and livestock watering.

By definition pumping locations in the management area may not necessarily be the same as the location of use because groundwater can be pumped from a well or well field and transported by pipeline to another geographic location within or outside the management area. Accordingly, GMA-1 district representatives reviewed and considered aquifer uses as described in the regional planning process and through discussion considered both the places of use and points of withdrawal since the availability of groundwater supply is highly dependent on the points of withdrawal (a well or well field).

From 2010 through the beginning of 2015, the Joint Planning Area experienced one of the most severe droughts on record. The drought resulted in significantly higher municipal groundwater use when the Canadian River Municipal Water Authority increased its groundwater pumping rate to offset diminishing surface water supplies. Similarly, irrigation use skyrocketed as the result of a combination of high commodity prices and the increased need for water to sustain crops in extended drought conditions. Since 2011, groundwater pumping has generally declined in the management area as the drought conditions have receded. However, aquifer uses and conditions still vary across GMA-1 as aquifers themselves differ across distance and usage differs significantly based on surface geography. Economic drivers also vary widely across the planning area.

Groundwater is pumped for agriculture irrigation in all eighteen counties and constitutes over 90% of the groundwater withdrawn in the management area. In 2013 for example, irrigated agriculture accounted for 2.06 million acre-feet of the total 2.22 million acre-feet of groundwater pumped in GMA-1 according to TWDB groundwater pumping estimates. Approximately 68% (1.41 million acre feet in 2013) of all irrigated agriculture groundwater use in GMA-1 was pumped in Dallam, Hartley, Moore and Sherman Counties located in northwestern part of the management area. Within these counties groundwater is produced from hydraulically connected Dockum, Rita Blanca, and Ogallala aquifers. The high groundwater pumping levels in those four counties generally result in some of the largest water level decline conditions within the management area. It is important to note that the recharge of these aquifers in the GMA-1 Joint Planning Area averages less than one inch per year. The high groundwater production amounts for this geographic area in the Northwest portion of the planning area differs substantially from the other fourteen counties within GMA-1.

Municipal water supply is the second largest water user group and accounts for approximately 5% of the total groundwater withdrawals. In 2013, municipal water supply accounted for 113,679 acre-feet in the management area. The two largest municipal water users are the City of Amarillo and the Canadian River Municipal Water Authority. Well fields for these entities are located in Roberts, Ochiltree, Carson, Potter and Randall Counties. In addition to these two primary municipal water suppliers, approximately forty smaller cities and water supply corporations within the area use groundwater as their primary and in most cases only water source. Approximately 80% of the source water for municipal use is supplied by groundwater and the remaining 20% is supplied by surface water. However, the drought that began in late 2010 forced the Canadian River Municipal Water Authority to accelerate the installation of well

fields and pumping of groundwater to replace the diminishing surface water source starting in 2011. In 2013, 51,000 acre-feet of groundwater was withdrawn for municipal purposes from Roberts County. Most of these withdrawals were previously supplied by Lake Meredith.

Manufacturing water supply accounts for less than 1% of the total groundwater use in the management area. According to the TWDB, 14,980 acre-feet of groundwater was withdrawn for manufacturing purposes in Carson, Gray, Hutchison, Moore and Potter counties in 2013.

Mining water supply accounts for 0.12% of the total groundwater pumped in the management area in 2013. TWDB water use data show that 2702 acre-feet of groundwater was pumped for mining water supply including petroleum development from Hemphill, Hansford, Lipscomb, Moore, Ochiltree, Oldham, Potter, Roberts, Sherman, and Wheeler Counties for that year. High oil and gas prices in 2013 and 2014 resulted in increased exploration in these counties, and this market fluctuation did create a slightly higher demand for water use in mining. However, lower market prices in 2015 normalized this use.

Steam-Electric water supply is used directly for power generation for the purpose of selling electricity. According to the TWDB, Moore and Potter Counties reported steam-electric groundwater use of 958 acre-feet for 2013 representing 0.04% of the total groundwater pumped in the management area. A large portion of the water used in steam electric generation within the region is sourced in reuse, and this keeps the groundwater contribution to this use very minimal.

Livestock water supply includes water used for confined animal feeding operations. According to TWDB data, livestock operations pumped 32,124 acre-feet of groundwater in 2013 representing approximately 1.44% of the total groundwater pumped in the management area. Most of the groundwater used for livestock was pumped in Dallam, Hansford, Hartley, Moore and Sherman Counties.

2016 Regional Water Planning Group projections indicate that total water use in the management area will decline over the 2020-2070 period, primarily due to an expected reduction in agricultural irrigation water requirements as a result of more efficient agricultural practices. Irrigation water use is expected to decline because of projected insufficient quantities of groundwater to meet future irrigation water demands (primarily in Dallam, Hartley, Moore and Sherman Counties), implementation of conservation practices, implementation of new crop types, and the use of more efficient irrigation technology.

Supporting documentation regarding this factor is found in the reference folder under AQUIFER USES AND CONDITIONS.

Factor 2 -The water supply needs and water management strategies included in the state water plan.

Texas Water Code 36.108 (d)(2) requires the districts to consider the water supply needs and water management strategies included in the state water plan. The GMA-1 voting membership received information on, discussed, and ultimately considered water supply needs and water management strategies within GMA-1 on May 30, 2014, August 19, 2014 and _____. The district representatives considered information from the 2011 Panhandle Regional Water Plan adopted by reference in the 2012 Texas State Water Plan and the 2016 Panhandle Regional Water Plan currently in review by the TWDB to be adopted in the 2017 State Water Plan. Texas Water Code §16.051 requires that not later than January 5, 2002, and before the end of each successive five-year period after that date, the Texas Water Development Board shall prepare, develop, formulate, and adopt a

comprehensive state water plan that incorporates the regional water plans. The state water plan shall provide for the orderly development, management, and conservation of water resources and preparation for and response to drought conditions, in order that sufficient water will be available at a reasonable cost to ensure public health, safety, and welfare; further economic development; and protect the agricultural and natural resources of the entire state. The most recent state water plan was approved in 2012. Since the 2012 State Water Plan incorporates the regional water plans, GMA-1 Joint Planning Committee utilized the detailed information in the 2011 Panhandle Regional Water Plan. Similarly, the body utilized data, strategies, and projections included in the recently adopted 2016 Panhandle Regional Water Plan that has yet to be approved by TWDB for incorporation into the 2017 State Water Plan.

In 2011, the Panhandle Water Planning Group identified twenty-seven WUGs (accounting for basin and county designations) with identified shortages during the planning period from 2010 to 2060. Of these, there are four city and other water users in three counties that are projected to experience a water shortage before 2060. The largest shortages are attributed to high irrigation use and comparably limited groundwater resources in Dallam, Hartley, Moore, and Sherman Counties. A shortage occurs when developed supplies are not sufficient to meet projected demands in a given area.

According to that 2011 Plan, total shortages for all water user groups are projected to be approximately 454,726 acre feet per year in 2010, increasing to 484,176 acre feet per year in 2030 and declining back down to nearly 415,317 acre-feet per year by the year 2060. Of this amount, irrigation represents approximately 99% in the 2010 projections and over 84% of the total shortage in 2060, with shortages ranging from 454,000 to 381,000 acre-feet per year. The shortages attributed to the other water use categories total approximately 34,000 acre-feet per year in 2060.

Irrigation – The Panhandle Water Planning Group identifies irrigation shortages for Dallam, Hansford, Hartley, Hutchinson, Moore, and Sherman Counties. All of these counties rely heavily on the Ogallala for irrigation supplies. Shortages are observed in five counties starting in 2010.

Municipal - The Panhandle Water Planning Group typically identifies municipal supplies in GMA-1 as groundwater; while surface water is used in counties with limited groundwater and by river authorities and their member cities to supply their customers. For some cities, there is additional groundwater supply but it is not fully developed and thus not accessible for these purposes. **Manufacturing** – The Panhandle Water Planning Group identifies three counties with manufacturing shortages identified in GMA-1. Most manufacturing interests buy water from retail providers or develop their own groundwater supplies. For each of these counties, much of the shortage is associated with wholesale water providers. For Moore County, these shortages are the result of limited groundwater supplies for the City of Cactus. In Potter County, the shortages are associated with shortages identified with the City of Amarillo. In Hutchinson County the shortages are associated with the City of Borger.

Mining - Panhandle Water Planning Group identified no mining shortages in GMA-1.

Steam Electric Power – The Panhandle Water Planning Group identified one steam electric power shortage identified in Moore County. The shortage is projected to be less than 100 acre-feet per year beginning in 2010; by 2060 this shortage is projected to be approximately 150 acre-feet per year.

Livestock – The Panhandle Water Planning Group projects that there are no identified livestock shortages in the Panhandle Planning Area. This is because it is determined that if there was sufficient supply available within the county, this supply would be developed by livestock producers. For most counties, water for livestock is from groundwater and/or local stock ponds. In the heavily pumped counties, there will be competition for groundwater supplies. Because of this, it can be assumed that the decrease in water used for irrigation will be available for livestock use.

According to the 2011 Panhandle Regional Water Plan, the Panhandle Water Planning Group concludes, on a water user group basis, the total demands exceed the total developed supply starting in 2010, largely attributed to the geographical constraints of the demand centers and developed supplies. Most of the shortages are associated with large irrigation demands that cannot be met with groundwater sources beneath currently irrigated lands. Other shortages are due to limitations of infrastructure and/or growth. The evaluation of regional water supplies indicates that groundwater supplies could be further developed to meet these needs. However, often the needed infrastructure is not developed or the potential source is not located near a water supply shortage.

The Panhandle Water Planning Group recommended water management strategies in the 2011 Regional Water Plan including:

- Conservation,
- Developing new groundwater well fields in the Ogallala and Dockum aquifers,
- Purchasing water from wholesale providers as they develop new strategies, and
- Acquiring additional groundwater rights.

Conservation is an important strategy in the region, as it is the only recommended strategy for the large irrigation deficits projected for GMA-1. Agriculture conservation is further elaborated upon in the 2016 Panhandle Regional Water Plan. There are potential cumulative water savings of up to 29 million acre-feet over the planning period from these strategies for the region. For the counties with shortages, the recommended irrigation conservation water savings total 458,551 acre-feet per year by 2060. If realized, this represents a large %age of the projected need in GMA-1.

Conservation alone cannot meet the entire irrigation shortage, or the other projected shortages. Continued reliance on groundwater from the Ogallala will be needed. Users will likely continue to acquire additional water rights and develop those rights as needed. Voluntary transfers of water are recommended, and will likely occur through natural economic changes in the region. In addition, opportunities for reuse in the PWPA will continue to be explored to meet long-range manufacturing needs.

According to the State Water Plan, Approximately 2% of the state's total population resided in the Panhandle Region in the year 2010. Between 2010 and 2060, population is projected to increase 39 % to 541,035. The region's total water demands, however, are projected to decrease, driven by a decline in agricultural irrigation, which is the largest water user in the region by at least twenty fold.

The region primarily relies upon groundwater supply sources, with approximately 88% of the existing water supply in the Panhandle Region coming from the Ogallala aquifer. Other aquifers (Blaine, Dockum, Seymour, and Rita Blanca) provide approximately 7% of the total supply, and surface water contributes

only 3% of supplies. Reuse contributes the remaining 2% of existing water supply in the planning area. Within the region, of the supplies available from the Ogallala aquifer, 85% is used for irrigation purposes. Based on the region's adopted water management policy, annual water supplies for the region from the Ogallala aquifer are projected to decline 37% by 2060 due to minimal recharge and extensive pumping.

In the event of drought, water needs occur across the region in all decades. The majority of the needs are in irrigation, with some other, smaller needs, primarily in municipal and manufacturing.

The 2012 State Water Plan identifies that conservation strategies represent 86% of the total volume of water associated with all recommended strategies. Water conservation is recommended for every municipal need and for all irrigation water user groups in the region. Irrigation conservation would be achieved through irrigation equipment improvements, conservation tillage practices, modifications in crop types, and the adoption of drought-resistant crop varieties.

Additional documentation regarding this factor is found in the reference folder under NEEDS AND STRATEGIES.

Factor 3 Hydrological conditions, including for each aquifer in the management area the total estimated recoverable storage as provided by the executive administrator, and the average annual recharge, inflows, and discharge;

Texas Water Code 36.108 (d)(3) requires the districts to consider hydrological conditions, including for each aquifer in the management area the total estimated recoverable storage as provided by the executive administrator, and the average annual recharge, inflows, and discharge. The Texas Water Code requires GMA-1 district representatives to consider Total Estimated Recoverable Storage (TERS) for each aquifer in the management area provided by the executive administrator (EA). District representatives received information on, discussed, and ultimately considered hydrological conditions on May 30, 2014, August 19, 2014, November 6, 2014, February 18, 2015 and _____, 2016. In December 2015, the EA of the TWDB forwarded the TERS to GMA-1. Originally, the district representatives received a presentation and background information related to hydrologic condition within GMA-1 on May 30, 2014. As part of the presentation, the committee received a presentation on "Total Estimated Recoverable Storage". TERS does not account for a variety of important conditions and aquifer characteristics that limit groundwater production such as well withdrawal rate, well density, hydraulic conductivity, withdrawal costs, aquifer petrology, permeability, and potential water quality degradation, etc. The TERS calculation represents the approximate percentage of total storage in the water-producing zones of an aquifer; however, not all of the water in those zones is "practically recoverable". Recovery of all water from TERS would take longer than the fifty year planning horizon and at a cost impractical for regional uses. Therefore, TERS accounts for water that cannot be practically produced for beneficial use at any level. Unlike TERS, the highest practicable level of groundwater production is defined as a rate. The EA provides total TERS as part of TWDB GAM Task 15-006 (December 2015). Texas Administrative Code §356.10 defines "Total Estimated Recoverable Storage" as the estimated amount of groundwater within an aquifer that accounts for recovery scenarios that range between 25% and 75% of the porosity-adjusted aquifer volume. Though estimated recoverable storage is defined by rule, the actual ability to "recover" from certain aquifers may often be less than 25% and rarely above 75%. The lower end of this estimate is highly unlikely to be attainable in GMA-1.

While the GMA-1 district representatives consider TERS as a characteristic of overall aquifer conditions, the districts are required by statute to propose and consider DFCs that balance between the highest practicable rate of groundwater production and conservation, preservation, protection, recharging, and prevention of waste of groundwater and control of subsidence.

Rita Blanca Aquifer

According to Texas Water Development Board Report 380, the Rita Blanca aquifer is located in northwest Dallam and Hartley Counties and sub-crops below the Ogallala aquifer and overlies the Dockum aquifer. The strata in the Rita Blanca aquifer range in age from Jurassic to Cretaceous. The Rita Blanca is hydraulically connected to the Ogallala & Dockum aquifers. The TWDB estimates that the Rita Blanca aquifer stores 11,100,000 acre-feet in Dallam and Hartley Counties and has a TERS between 2,775,000 acre-feet and 8,325,000 acre-feet.

Ogallala Aquifer

The Ogallala aquifer was deposited as sediments on a massive alluvial fan that ranged from South Dakota to Big Spring, Texas. The sediments were carried by braided streams from the ancestral Rocky Mountains eastward, terminating in central Nebraska, Kansas and western Oklahoma. The Ogallala aquifer is an unconfined water table aquifer extending through 48 counties in the Texas High Plains and Panhandle area. The aquifer extends throughout all 18 counties in the management area. There is a natural separation between the Northern Ogallala and Southern Ogallala at the Canadian River running through GMA-1. The characteristics of the aquifer change slightly from the Northern to the Southern portions. The TWDB estimates that the Ogallala aquifer stores 232,700,000 acre-feet and has a TERS between 58,175,000 acre-feet to 174,525,000 acre-feet in the GMA-1 Joint Planning Area.

Dockum Aquifer

The Dockum aquifer is a minor aquifer within Texas but, according to Groundwater Availability Modeling this aquifer has more groundwater within storage (319,000,000 acre-feet in GMA-1 than the Ogallala Aquifer. However, the confining conditions of the Dockum aquifer greatly reduce its probable recoverable groundwater. The Dockum aquifer has an outcrop area of 3,519 square miles and a subsurface area of 21,992 square miles. The TWDB estimates that the Dockum aquifer stores 291,840,000 acre-feet and has a TERS between 72,960,000 acre-feet to 218,880,000 acre-feet in Armstrong, Carson, Dallam, Hartley, Moore, Oldham, Potter, Randall and Sherman Counties in the management area. In areas where the Dockum is confined by the overlying Ogallala aquifer and other aquifers, TERS may be much lower than 25%. Additionally, water quality concerns with the Dockum aquifer further reduce the likelihood that it will be heavily pursued in the 50 year timeline of this Joint Planning process.

Blaine Aquifer

The Blaine aquifer strata consist of the Blaine Formation (Peace River Group) - red silty shale, gypsum, anhydrite, salt, and dolomite. The sediments of the aquifer originated as part of Permian marine and non-marine sedimentary cycles deposited in a broad, shallow sea. Groundwater in the Blaine aquifer occurs primarily in solution channels and caverns within anhydrite and gypsum. The Blaine aquifer's water quality ranges from slightly saline (1000-3000 mg-l) to moderately saline (3,000-10,000 mg-l). The Blaine aquifer is a confined aquifer located, in part, in southern Wheeler County in the Panhandle

Groundwater Conservation District. Due to both limited volume and accessibility, the GMA-1 Joint Planning Committee has determined that the Blaine aquifer was not of sufficient relevance to joint plan and set a desired future condition.

Seymour Aquifer

The Seymour aquifer is a major unconfined (water table) aquifer in Texas but has a very limited extent in GMA-1. A very small segment of the Seymour aquifer is located in eastern Donley County and has an estimated total storage in the county of only 760 acre-feet. The aquifer is part of the Seymour Formation containing discontinuous beds of poorly sorted gravel, conglomerate, sand, and silty clay. The Seymour originated as Quaternary Alluvial sediments overlying Permian-age rocks

The GMA-1 Joint Planning Committee previously determined that the Seymour aquifer was not of sufficient relevance to joint plan and set a desired future condition.

Additional documentation regarding this factor is found in the reference folder under AQUIFER CONDITIONS.

Factor 4 Environmental impacts, including impacts on spring flow and other interactions between groundwater and surface water

Texas Water Code §36.108 (d)(4) requires that before voting on the proposed desired future conditions of the aquifers, the districts shall consider other environmental impacts, including impacts on spring flow and other interactions between groundwater and surface water within a management area. The district representatives received information on, discussed, and ultimately considered environmental impacts, including impacts on spring flow and other interactions between groundwater and surface water within GMA-1 on May 30, 2014, August 19, 2014 and _____, 2016.

According to the High Plains Aquifer System groundwater availability model water balance calculations, the Dockum aquifer on balance released 19,709 acre-feet of groundwater to springs, rivers, and draws annually during its steady state before groundwater pumping. The Dockum transitional model for 1980 indicates that the aquifer on balance released 19,572 acre-feet of groundwater into springs, rivers, draws and escarpments in the management area when groundwater pumping in the lower Dockum reached 10,709 acre-feet. The Dockum transitional model for 2012 indicates that the aquifer on balance released 18,952 acre-feet to springs, rivers, draws, and escarpments when pumping reached 12,415 acre-feet. Through the simulations, the lower Dockum aquifer recharge remained between 8572 acre-feet during the steady state simulation and 8706 acre-feet for both of the transitional simulations.

According to the High Plains Aquifer System groundwater availability model, the Ogallala aquifer on balance released 209,566 acre-feet of groundwater to springs, rivers, draws and escarpments annually during its steady state before groundwater pumping. The Ogallala transitional model for 1980 indicates that the aquifer released 136,195 acre-feet of groundwater into springs, rivers, draws and escarpments in the Joint Planning Area when groundwater pumping reached 1.8 million acre-feet. The Ogallala transitional model for 2012 indicates that the aquifer released 85,914 acre-feet to springs, rivers, draws, and escarpments when pumping reached 2.5 million acre-feet. Through the simulations, aquifer recharge remained between 324,889 acre-feet during the steady state simulation and 327,567 acre-feet for both of the transitional simulations.

According to the Hemphill County Underground Water Conservation report from August 19, 2014 and associated management plan, the Ogallala aquifer in Hemphill County received more recharge and in turn cumulatively provided more groundwater for springs, rivers, draws, and escarpments than any other county in the management area in steady state and both transitional model runs.

The steady state and the two transitional groundwater availability models showed that the Rita Blanca aquifer did not release groundwater to springs, rivers, draws and escarpments. Additionally, the Rita Blanca aquifer did not receive recharge.

Texas Administrative Code §357.30 requires regional water planning groups to describe current groundwater, surface water, and reuse supplies including major springs that are important for water supply or protection of natural resources.

As part of its evaluation of water related threats to agriculture and natural resources, the 2011 Panhandle Regional Water Plan says that reservoir development; groundwater development and invasion by brush have altered natural stream flow patterns in the area. Spring flows in the area have generally declined over the past several decades. Much of the impact to springs is because of groundwater development, the spread of high water use plant species such as mesquite and salt cedar, or the loss of native grasses and other plant cover. High water use plant species have reduced reliable flows for many tributary streams. Reservoir development also changes natural hydrology by diminishing flood flows and capturing low flows.

Continued depletion of the local aquifers will likely continue to impact base flows of local streams and rivers in the area. Spring flows can be affected by changes in groundwater levels. Of the counties pumping from the Ogallala aquifer, Moore County experienced the greatest decreases in groundwater levels since 1950 (up to a 200 ft. decrease). Sherman, Dallam, Carson, Hartley, Hutchinson, and Hansford Counties experienced draw-downs of up to 120 ft. Spring flow in these counties could be decreasing due to increased pumping from the aquifer. Historic records indicate that increased pumping generally results in decreased spring flow.

The Eastern counties within GMA 1 continue to have annual flow in many of the creeks and streams located in Lipscomb, Hemphill and Wheeler counties. The Ogallala aquifer is a water source for these creeks and streams because the stream beds are incised below the water table, making them gaining streams, or incised below the Ogallala aquifer redbed, creating springs that drain the aquifer at its base.

Changes in historical water levels in the Dockum aquifer could also be contributing to declining lake levels in Lake Meredith. The area of greatest drawdown in the Dockum occurs beneath Lake Meredith and the 30 miles of the Canadian River leading up to the reservoir. According to this analysis conducted as a special study included in the 2011 Panhandle Regional Water Plan, groundwater levels have dropped by more than 250 ft. in some areas of the watershed since the 1960s. The precipitous decline in inflows to Lake Meredith could be related to draw downs in Dockum water levels and invasive high water use plant species during same period of time.

Under regional planning guidelines, each planning region may recommend specific river or stream segments to be considered by the Legislature for designation as ecologically unique. The Legislative designation of a river or stream segment would only mean that the State could not finance the construction of a reservoir that would impact the segment. The intent is to provide a means of

protecting the segments from activities that may threaten their environmental integrity. There are no reservoirs included as strategies in either the 2011 or 2016 Panhandle Regional Water Plans, and as a result there is no necessity for river or stream segments to be cited as ecologically unique.

Texas Parks and Wildlife Department (TPWD) requires that, in part, segments and spring resources that are significant due to unique or critical habitats and exceptional aquatic life uses dependent on or associated with high water quality be used when recommending a unique river or stream segment. TPWD compiled a listing of ecologically significant stream segments located in PWPA. As part of the planning process, fourteen segments were evaluated by the PWPG for potential recommendation as unique stream segments. After careful consideration of the unknown consequences of recommendation, the PWPG made no recommendations for river and stream segments of unique ecological value in the adopted plan. Further, the TPWD had opportunity to provide comment on the Initially Prepared Plan, and there were no material comments related to ecologically significant stream segments identified at that time.

Supporting documentation regarding this factor is found in the reference folder under ENVIRONMENTAL IMPACTS.

Factor 5 The impact on subsidence

Texas Water Code 36.108 (d) (5) requires the districts to consider the impact on subsidence. District representatives received information on, discussed, and ultimately considered impacts of the DFCs on land subsidence on August 19, 2014 and _____. Largely based on the 2011 and 2016 Panhandle Regional Water Plans and individual district records, the GMA-1 voting membership propose that there are no significant impacts on subsidence caused by groundwater withdrawals from the Rita Blanca, Ogallala, or Dockum aquifers in the Joint Planning Area. Land subsidence may occur when large amounts of groundwater are withdrawn from certain types of aquifers, such as those consisting of fine-grained sediments. Compaction of sediments can accompany excessive ground-water pumping and it is by far the single largest cause of land subsidence. The sediment compacts because the water removed was partly responsible for holding the ground up. Increasing development of land and water resources threatens to make existing land-subsidence problems worse and initiate new ones. Land subsidence is of greatest threat to areas where the water table is shallow, municipal and infrastructure is greatest (resulting in potentially greater financial damage) and in areas where oxidation of near surface soil zones can contribute to subsidence.

Groundwater in the management area is generally withdrawn from significant depth and is overlain by well compacted or consolidated strata making land subsidence less likely to occur than in other regions of the State. GMA-1 is predominately rural and is in general less developed than certain regions of the State such as the Houston or the coastal area. Potential financial loss or damage to infrastructure is much less likely to be significant in less developed areas.

Supporting documentation regarding this factor is found in the reference folder under IMPACT OF SUBSIDENCE.

Factor 6 socioeconomic impacts reasonably expected to occur from the adoption of proposed DFCs.

Texas Water Code Section 36.108(d)(6) requires that district representatives consider the socioeconomic impacts reasonably expected to occur from the adoption of proposed DFCs. As part of its consideration,

the district representatives were presented with historic analysis. They reviewed, discussed, and ultimately considered socioeconomic impact studies prepared by the TWDB for regional water planning purposes, as well as studies that target areas in GMA-1 that may experience socioeconomic impacts based on the selected DFCs on August 19, 2014 and _____, 2016. District representatives reviewed three studies regarding the socioeconomic impacts as follows:

- “Socioeconomic Impacts of Projected Water Shortages for the Panhandle (Region A) Regional Water Planning Area”
- “Evaluation of Changing Land Use and Potential Water Conservation Strategies North Plains Groundwater Conservation District”
- “Economic Impacts of Groundwater Management Standards in the Panhandle Groundwater Conservation District of Texas”
- “The Economic Value of Irrigation in the Texas Panhandle”
- “The Impact of the 2011 Drought and Beyond”

The report, “Socioeconomic Impacts of Projected Water Shortages for the Panhandle Regional Water Planning Area” constitutes the TWDB’s technical assistance for Planning and was prepared and completed in April 2010 in support of the 2011 Panhandle Regional Water Plan. The report, which can be found in Appendix I of the 2011 Panhandle Regional Water Plan, details what would happen if identified water shortages in the region were to go unmet. The report is based on regionally generated data that have been analyzed through the Impact Analysis for Planning (IMPLAN) model. The regional data is coupled with state level multipliers to produce the impacts presented.

The report is limited only to the impacts (direct impacts and some indirect) of not meeting water needs due to drought (drought of record) and provides a range of possible impacts based on severity of shortages. The report uses TWDB projected changes in demographics and economic activity and addresses the period 2010-2060. The monetary impacts are reported in 2006 dollars and address potential loss of employment, income and taxes. The results in the report utilize the economic IMPLAN model. This model was developed using estimates of demand, final payments, industry input-output and benchmark input-output generated by the US Bureau of Economic Analysis.

Agriculture

In the report, impacts to agriculture are distributed across predominate crop types of the region and estimate associated reductions in output for affected crop sectors and potential job loss. Shortages are assumed to affect all agriculture sectors equally across the planning area.

Livestock

Livestock takes into account cattle ranching, feedlot, dairies, poultry and other livestock as well as milk manufacturing and meat packing. As with agriculture, shortages are assumed to affect all agriculture sectors equally.

Municipal

Impacts to municipal users are broken into domestic, commercial use and commercial users and institutional use with several disclaimers about uncertainties in the estimates.

Industrial

Industrial impacts are addressed separate from municipal and commercial use, but they do address the manufacturing, mining (including oil & gas) and steam-electric industries.

Social

In the report social impacts focus strictly on demographic effects associated mostly with potential changes in population, declines in jobs, and impacts on local school enrollment.

The TWDB's analysis calculated the impacts of a severe drought occurring in a single year at each decadal period in the PWPA. It was assumed that all of the projected shortage was attributed to drought. Under these assumptions, the TWDB's findings can be summarized as follows:

- With the projected shortages, the region's projected 2060 population would be reduced by approximately 1%.
- Without any additional supplies, the projected water needs would reduce the region's projected 2060 employment by 5,700 jobs.
- Without any additional supplies, the projected water needs would reduce the region's projected annual income and taxes in 2060 by \$381 million.

At the request of the North Plains Groundwater Conservation District, researchers from Texas A&M AgriLife Extension, West Texas A&M University, and Texas Tech University prepared a report "Evaluation of Changing Land Use and Potential Water Conservation Strategies". The objective of this study is to evaluate the short and long-term implications of changing land use and alternative water conservation strategies being considered by the NPGCD. Specifically, the changing land use and water conservation strategies identified by the district were evaluated using computer models that project saturated thickness, producer gross margin, and impacts on the regional economy.

In one modeling scenario, agricultural production under the unconstrained scenario in the western counties causes impacts to the NPGCD Region of \$59 billion in output and \$24 billion in value added over the 50-year time horizon, and an annual average of approximately 6,400 jobs. The average initial saturated thickness in the eastern counties of the district started at 201 feet with an average gross margin of \$186.03 per acre. Under the projections the ending average saturated thickness was 180 feet with an average gross margin of \$293.22 per acre by year 50. Agricultural production under the unconstrained scenario in the eastern counties results in impacts to the NPGCD Region of approximately \$23 billion in output, \$9 billion in value added, and an annual average of 2,400 jobs.

In scenario 2 mirroring the current DFC's of GMA-1, water use was limited in each county to 40% of storage in 50 years in each of Dallam, Hartley, Moore and Sherman Counties and 50% remaining in 50 years in each of Hansford, Hutchison, Lipscomb and Ochiltree counties. A comparison of the unconstrained scenario and the constrained water use scenario results was conducted to evaluate the resultant impacts on saturated thickness, producer income and the regional economy over a 50-year time horizon. The DFC only resulted in restricted water use in Dallam and Hartley Counties. Under this scenario, average saturated thickness for the Western portion of the NPGCD decreased to 65.05 feet by year 50 which is 10% higher than the unconstrained scenario. Reduced yields resulted in a reduced average gross margin for the Western portion of \$163.35 per acre which is 25% lower than the unconstrained scenario. In addition, economic activity in the sub-region was reduced 3.5 billion dollars over the 50 years and an annual average of 239 jobs were lost compared to the unconstrained model. Evaluating the impacts of imposing a regional DFC rather than a county specific DFC in the western

counties helped to mitigate to an extent the overall negative economic impacts. Under this scenario ending gross margin was estimated to be \$50 per acre higher, economic activity over the 50-year time line was 1.3 billion more and annual employment averaged 87 more than the county specific DFC. However, region-wide saturated thickness did decline an additional 2.75 feet for the period. Further, the reality of the economic impact will likely be much more akin to the county specific scenario due to the localized nature of agricultural economies.

Researchers from the Texas Tech University Department of Agricultural and Applied Economics and Texas A&M AgriLife Extension Service evaluated the 50/50 management standard for the Panhandle Groundwater Conservation District on three specific yet linked levels. County level, specific study area, and farm level analyses were conducted to estimate the economic impacts of the 50/50 management standard on the economic viability of agriculture in the region. The county level and hydrologic study area optimization analyses were transferred into economic projections using IMPLAN estimating any spillover effects that the management standard would have to the region. In this case the region was defined as all counties PGCD has jurisdiction to impose the 50/50 management standard. The overall results indicate that the 50/50 management standard will have no significant effects on this portion of the planning area at all average levels of analysis including the county, hydrologic study area, and representative farm level. The only case in which the management standard impacted agricultural production practices was illustrated in an extreme case of drawdown on the Donley County High Drawdown Farm, where drawdown levels of the aquifer were simulated to be double the average for farms in the region. Even at these high rates of decline, the farm only indicated slight changes in economic viability as a result of the 50/50 management standard, and this scenario is only likely to affect a very small percentage of farmers within the region.

This study did not evaluate the economic impacts of an alternative water market where irrigated producers could sell their water in lieu of irrigated crop production. Had this market been included in this study, the economic projections would vary from what is presented. Potential impacts of this market sell-off could include; reduced commodity production within PGCD and reduced economic activity from agricultural input suppliers. Typically, agricultural producers receive a greater value for sold water in comparison to what can be generated on the farm. Hence, it is possible that farm level revenue would increase or at least be maintained under the addition of an external water market.

The management plan proposed by PGCD allows production agriculture to continue to be profitable and maintain generally the current rates of production while setting a goal (50/50) preventing excessive decline in groundwater resources. It is important to note that even with water conservation strategies such as the 50/50 in place, the economic activity of the region will naturally change and in some cases decline as irrigation water availability is reduced through the mining of the Ogallala aquifer.

Hemphill County Underground Water Conservation District has indicated in GMA-1 meetings that the rate of 80/50 would likely allow all producers in the County to produce at least twice the historical rate of exempt and non exempt production.. The amount of irrigated agriculture is the least of any county in the GMA. Because the DFC allows for considerable additional production it is not expected that the proposed DFC of 80/50 for Hemphill County would adversely affect the economy of the County.

Additional documentation regarding this factor is found in the reference folder under SOCIO ECONOMIC STUDIES

Factor 7 The impact on the interests and rights in private property, including ownership and the rights of management area landowners and their lessees and assigns in groundwater as recognized under Section 36.002.

Texas Water Code 36.108 (d) (7) requires the districts to consider the impact on the interests and rights in private property, including ownership and the rights of management area landowners and their lessees and assigns in groundwater as recognized under Section 36.002. District representatives received presentation, discussion and ultimately considered the impact on the interests and rights in private property, including ownership and the rights of management area landowners and their lessees and assigns in groundwater February 18, 2015 and _____, 2016. District representatives received a presentation by North Plains GCD attorney, prepared with assistance from legal representation from the other three participating GCDs, regarding Texas Water Code 36.108 (d) (7) and considered the property interests and rights related to the production and conservation of groundwater in GMA-1 including:

1. Interests and rights that are benefitted or enhanced by the present use of groundwater;
2. Interests and rights that are benefitted or enhanced by the use of groundwater in the near future;
3. Interests and rights that are benefitted or enhanced by the ability to use groundwater over the long-term; and
4. Interests and rights that are benefitted or enhanced by leaving a significant amount of groundwater in place.

On February 18, 2015 the voting membership of GMA#1 received a presentation from the North Plains GCD Legal Counsel regarding the impact of possible Desired Future Conditions on private property rights in the Joint Planning Area. Other participating districts are developing similar analysis with their respective legal representatives.

Additional documentation regarding this factor is found in the reference folder under PRIVATE PROPERTY RIGHTS.

Factor 8 The feasibility of achieving the desired future condition.

Texas Water Code 36.108 (d) (8) requires the districts to consider the feasibility of achieving the desired future condition. District representatives have received information, discussed, and ultimately considered the feasibility of achieving the DFCs April 11, 2014, November 6, 2014, and _____, 2016. During the last round of joint planning, the TWDB was required by statute to determine if DFCs were “reasonable”. The TWDB determination was based primarily on whether or not achieving the DFCs was possible. The district representatives used the High Plains Aquifer System Groundwater Availability Model, other groundwater models, and the TERS provided by the TWDB. The most recent Groundwater Availability Model (Task Run 15-006) from the TWDB indicates that the proposed Desired Future Condition is physically possible even within the constraints of Recoverable Storage. The available information shows that the DFCs are achievable and therefore, feasible.

Supporting documentation regarding this factor is found in the reference folder under FEASIBILITY.

Factor 9 Any other information relevant to the specific desired future conditions.

Texas Water Code 36.108 (d) (9) requires the districts to consider any other information relevant to the specific desired future conditions. District representatives discussed other information relevant to the specific desired future conditions November 6, 2014, and _____, 2016.

To this point, all material information related to the adoption of a proposed Desired Future Condition has been tied to one or more of the previously discussed factors. In order to get a detailed understanding of how the major municipal water users in the Joint Planning the GMA#1 received presentations from the City of Amarillo on November 6, 2014 and the Canadian River Municipal Water Authority on August 19, 2014 respectively. These presentations were considered in relationship to multiple factors discussed above. As such, no additional information has been designated as “other” at this time by the voting membership of the GMA-1.

Supporting documentation regarding this factor is found in the reference folder under OTHER INFORMATION.

Public Comment:

The GMA#1 received formal public comment in the form of an email from J. Collier Adams of Morton, Texas on October 13, 2014 for inclusion in the public record for the November 6, 2014 GMA#1 Meeting. The full correspondence is located in the reference folder under PUBLIC COMMENT. The fundamental nature of the comment is that the Joint Planning Process and associated Regional Water Planning Process are fundamentally in violation of constitutionally protected human rights due to their requirements of water conservation.

To date, no other public comments have been received related to the establishment of Desired Future Conditions or any other GMA-1 related topics.