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2026 REGION J WATER PLAN
Prepared for
The Plateau Water Planning Group

March 3, 2025

Carollo Engineers, Inc.

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2026 REGION J WATER PLAN

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EXECUTIVE SUMMARY

Located along the southern boundary of the Edwards Plateau, the Plateau Water Planning Region stretches from the Central Texas Hill Country westward to the Rio Grande and consists of Bandera, Edwards, Kerr, Kinney, Real and Val Verde Counties (Figure ES-1). Tourism, hunting, ranching, agribusiness, government and military activities support the regional economy. The beauty of the Hill Country, the solitude of the forested canyons and plateau grasslands, and the gateway to Mexico all support a major tourist and recreational trade. Natural resources of the Region include both terrestrial and aquatic habitats that boast some of the best scenic drives, beautiful vistas, river rafting, and hunting and fishing in Texas.

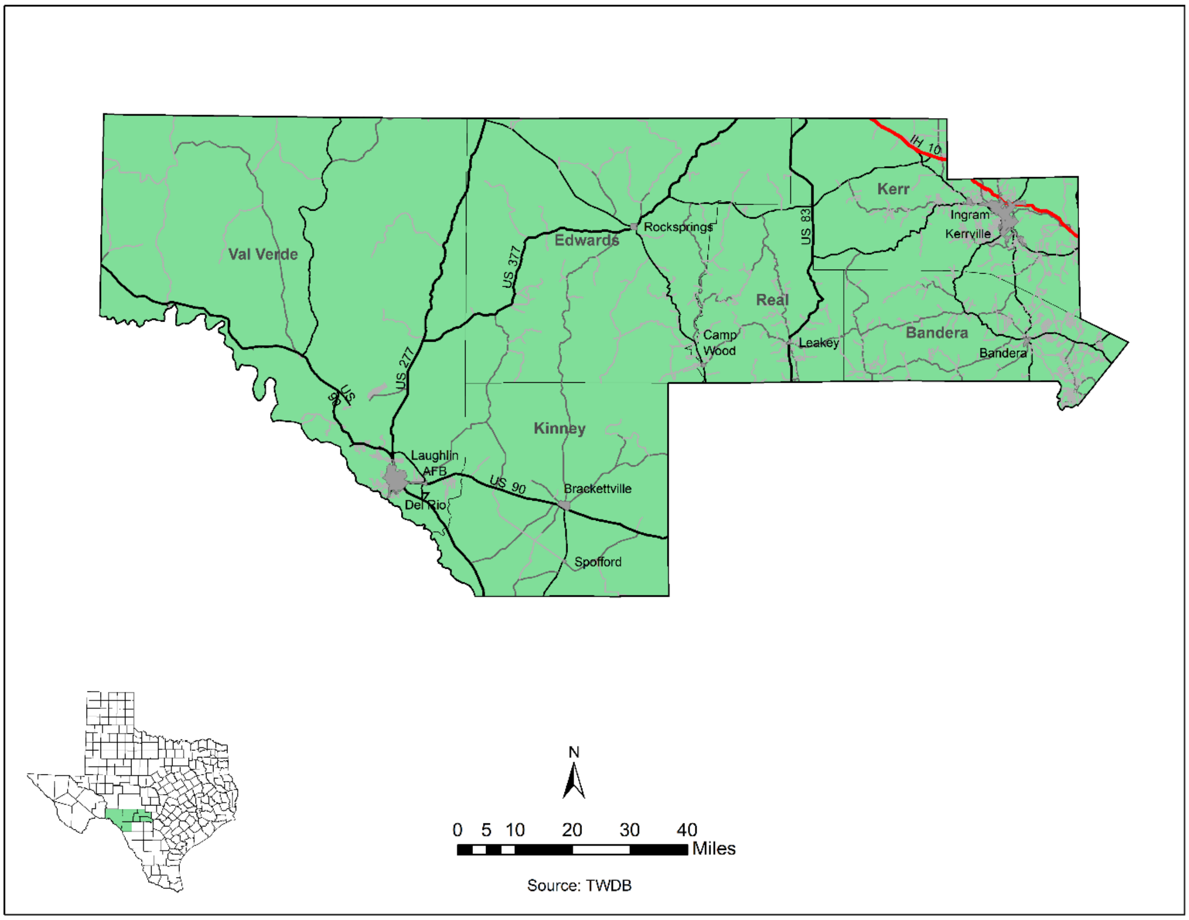

Figure ES-1. Plateau Region Water Planning Area Map

In January of 2021, the fifth round of regional water planning was concluded with the adoption of the *2021 Plateau Region Water Plan*. It is understood that this is not a static *Plan* but rather is intended to be revised as conditions change. For this reason, the current *2026 Plateau Region Water Plan* put forth in this document is not a new *Plan*, but rather an evolutionary modification of the preceding *Plan.* Only those parts of the original *Plan* that require updating, and there are many, have been revised.

The purpose of the *Plateau Region Water Plan* is to provide a document that water planners and water users can reference for long- and short-term water management recommendations. Equally important, this *Plan* serves as an educational tool to enlighten all citizens to the importance of properly managing and conserving the pristine water resources of this Region. The *2026 Plateau Region Water Plan* follows an identical format as the *Plans* prepared by the other 15 water planning regions in the State as mandated by the Texas Legislature and overseen by the Texas Water Development Board. The *Plan* provides an evaluation of current and future water demands for all water-use categories, and water supplies available during drought-of-record conditions to meet those demands. Where future water demands exceed an entity's ability to supply that need, alternative strategies are considered to meet the potential water shortages. Water management strategies are also presented that reflects an entity's desire to upgrade their water supply system. In all cases, conservation practices are first considered in managing water supplies.

Because our understanding of current and future water demand and supply sources is constantly changing, it is intended for this *Regional Water Plan* to be revised every five years or sooner if deemed necessary. This *Plan* fully recognizes and protects existing water rights, water contracts, and option agreements, and there are no known conflicts between this *Plan* and plans prepared for other regions.

This Executive Summary provides an overview of the 10 chapters of the *2026 Plateau Region Water Plan.* All required TWDB DB27 reports used in the development of this *Plan* can be accessed on the TWDB's Database Reports application website. Please follow the instructions below to access specific reports in the application.

1. Navigate to the TWDB Database Reports application at TWDB Database Reports - Secure Agency Reporting Application.
2. Enter '2026 Regional Water Plan' into the "Report Name" field to filter to all DB27 reports associated with the 2026 Regional Water Plans.
3. Click on the report name hyperlink to load the desired report.
4. Enter planning region letter parameter, click view report.

POPULATION AND WATER DEMAND

The U.S. Census Bureau performed a census count in 2020, which provides the base year for future population projections. Although the Plateau Water Planning Group (PWPG) accepts the 2020 census count, members express concern that the census does not recognize the significant seasonal population increase that occurs in these counties as the area draws large numbers of hunters and recreational visitors, as well as absentee landowners who maintain vacation, retirement, and hunting properties. The PWPG requested revisions to specific population and municipal water demand categories for use in the *2026 Plateau Region Water Plan*, which were subsequently approved by the TWDB. Thus, the population and water demand projections shown in this *Plan* are derived from a combination of TWDB data and the approved revisions.

The Plateau Region covers 9,252 square miles and contains a projected year-2030 population of 140,468. The mostly rural nature of this Region is reflected in its population density of 15.3 (in 2030) people per square mile, which is significantly less than the State average of 72 people per square mile. Approximately 49 percent of the total population of the area is located in the two largest cities, Del Rio and Kerrville. In the year 2030, Del Rio, including the population of Laughlin Air Force Base, is projected to have 37,572 residents and Kerrville with 33,035. The projected year-2030 populations of other major communities in the Region are Bandera (1,949); Rocksprings (666); Brackettville and Fort Clark Springs (2,449); and Camp Wood (339) and are presented in Figure ES-2. These population estimates do not include a significant transient (tourist, hunting, recreation, etc.) population that has a resulting significant impact on overall water supply demand in the Region.

Total population of the six counties is expected to increase from 140,468 in 2030 to 154,530 by 2080. The greatest percentage increase in population is projected to occur in Kerr County, which is expected to grow from a projected year-2030 population of 57,139 to 70,356 by the year 2080, an increase of 22 percent. Bandera County (10 percent) and Val Verde County (two percent) are also anticipating growth. Population in the rural counties of Edwards, Kinney and Real is expected to decrease slightly over the 50-year planning period, however the transient population will likely increase.

Total projected water consumptive use/demand in the Plateau Region in the year-2030 is 50,980 acre-feet per year. The largest category of projected demand is municipal and county-other (32,738 acre-feet per year), followed by irrigation (15,235 acre-feet per year), livestock (2,655 acre-feet per year), mining (312 acre-feet per year), and manufacturing (37 acre-feet per year) as illustrated in Figure ES-3. Municipal and irrigation combined represent 94 percent of all water used in the Region. The forecasted total demand for water needed in the Region will increase from 50,980 acre-feet per year in 2030 to 53,522 acre-feet per year by 2080.

The largest center of municipal demand in the Region is the City of Del Rio in Val Verde County, where 12,977 acre-feet per year of water is projected to be used in 2030 to supply the residents and businesses within the City. Forty one percent of the Region's total municipal water use occurs in Val Verde County. The City of Del Rio is the only entity in the Plateau Region that is designated as a wholesale water provider. In addition to its own use, the City provides water to Laughlin Air Force Base and subdivisions outside of the City.

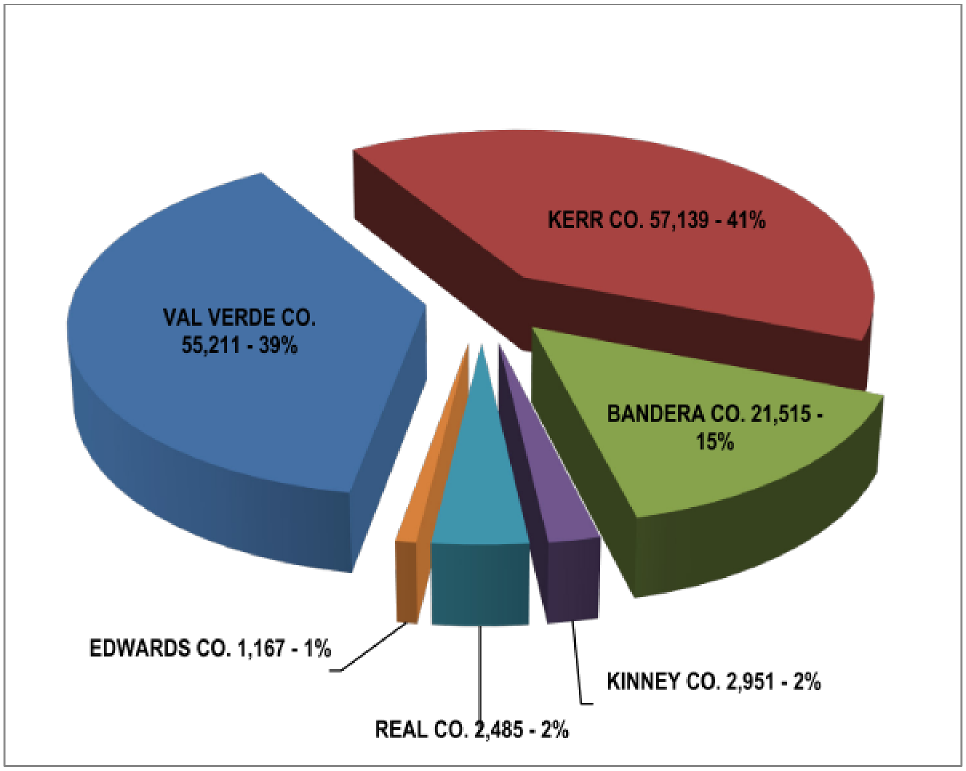

Figure ES-2. Year 2030 Projected Population

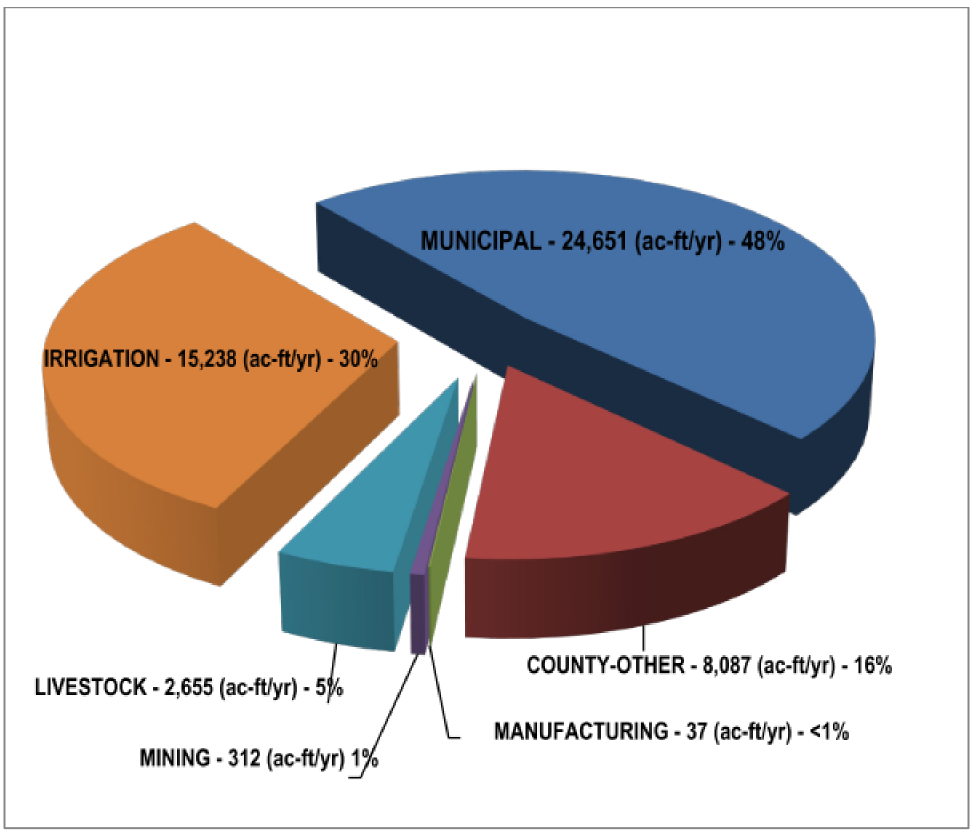

Figure ES-3. Year 2030 Projected Water Demand by Water Use Category

The Upper Guadalupe River Authority (UGRA) anticipates becoming a wholesale water provider in coming years with the intent to provide conjunctive water-supply sources to meet the needs of Kerr County citizens that will not be served by the City of Kerrville.

Most irrigation that occurs in the Plateau Region is for the watering of pastures and hay fields. Because of the typically rocky and uneven terrain throughout much of the Region, irrigation of commercial row crops is minimal other than in Kinney County. Kinney County has the highest irrigation water use (44 percent of the Region's total) and is the only county in which irrigation use is greater than municipal use. On a regional basis, water used for irrigation is projected to remain consistent at 15,238 acre-feet per year over the 50-year planning horizon. However, as any irrigator can attest, climate, water availability, and the market play key roles in how much water is actually applied on a year-by-year basis.

Environmental and recreational water use in the Plateau Region is recognized as being an important consideration as it relates to the natural community in which the residents of this Region share and appreciate. In addition, for rural counties, tourism activities centered around the natural resources offer perhaps the best hope for modest economic growth to areas that have seen a long decline in traditional economic activities such as agriculture.

WATER SUPPLY RESOURCES

Water supply sources in the Plateau Region include groundwater from six aquifers (175,929 acre-feet per year in 2030), and surface water within five river basins (18,898 acre-feet per year in 2030) (Chapter 3, Table 3-1). Reuse of existing supplies is also considered a water supply source. Water supply availability under drought-of-record conditions is considered in the planning process to ensure that water demands can be met under the worst of circumstances. In the consideration of available water supply sources, this *Plan* fully recognizes and protects existing water rights, water contracts, and option agreements.

Within the Plateau Region, the TWDB recognizes three major aquifers [the Trinity, the Edwards-Trinity (Plateau), and the Edwards (Balcones Fault Zone)] as illustrated in Figure ES-4. For this *Plan*, the Austin Chalk Aquifer in Kinney County, and the Frio and Nueces River Alluvium Aquifers in Edwards and Real Counties are also identified as groundwater sources. Groundwater conservation districts in Bandera, Kerr, Kinney, Real and Edwards Counties provide for local management control of the groundwater resources in their respective districts. Over much of the Region, water levels generally fluctuate with seasonal precipitation and are highly susceptible to declines during drought conditions. Discharge from the aquifers occurs naturally through springs and seeps, and artificially by pumping from wells. Some discharge also occurs through leakage from one aquifer to another and through natural down-gradient subsurface flow out of the Region.

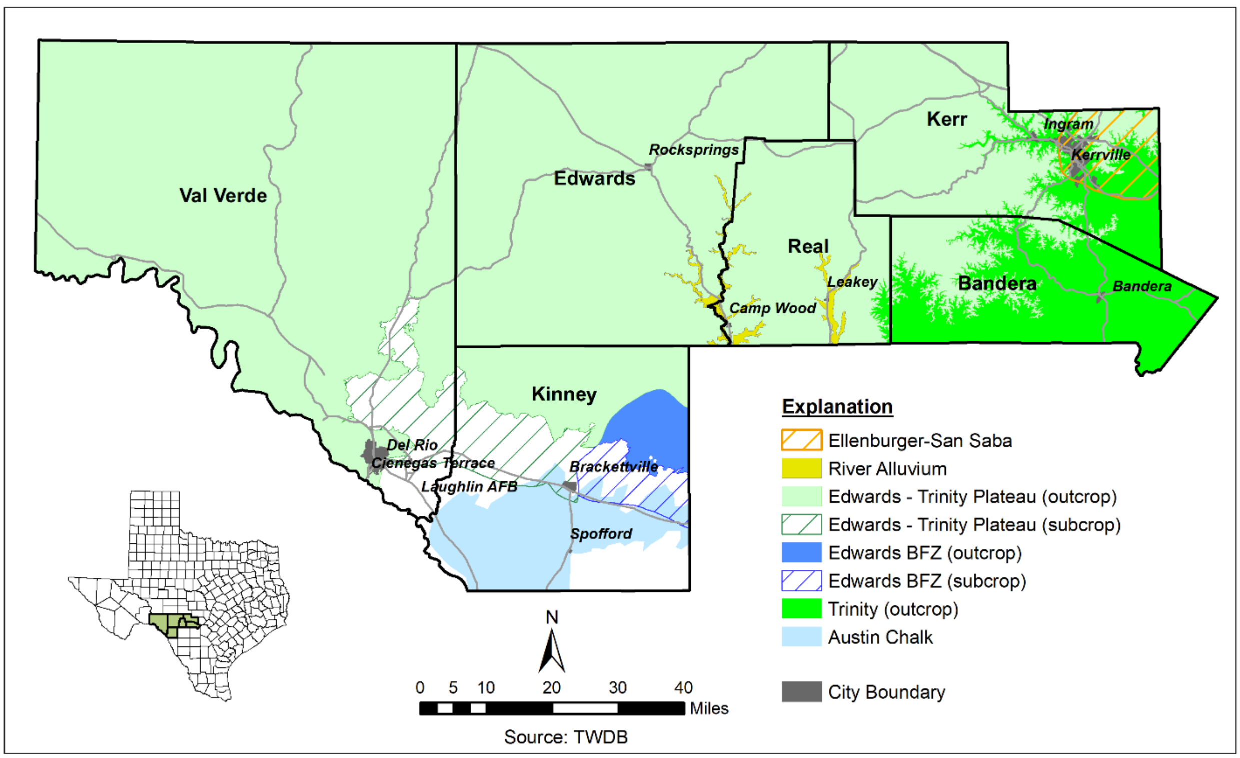

Figure ES-4. Groundwater Sources

Base flow to the many rivers and streams that flow through the Plateau Region is principally generated from the numerous springs that issue from rock formations that form the major aquifers. It is thus recognized that sustaining flow in these important rivers and streams is highly dependent on maintaining an appropriate water level in the aquifer systems that feed the supporting springs. With the sustainability of local water supplies and the economic welfare of the Region in mind, the PWPG thus defines groundwater availability as a maximum level of aquifer withdrawal that results in an acceptable level of long-term aquifer impact such that the base flow in rivers and streams is not significantly affected beyond a level that would be anticipated due to naturally occurring conditions. The PWPG also acknowledges that groundwater conservation districts have regulatory authority over permitted withdrawals.

The volumetric availability of groundwater for this *2026 Plan* is based on TWDB provided Modeled Available Groundwater (MAG) as developed through the Groundwater Management Area process. Aquifers recognized in this *Plan* that are not included in the GAM-MAG process are termed “non-relevant” and “other aquifer.” Groundwater availability for these sources is calculated by modeling or standard geohydrologic methods, with include the following:

The counties that comprise the Plateau Region contain the headwaters of the Guadalupe, San Antonio, Medina, Sabinal, Frio, Nueces, and West Nueces rivers; and tributaries to the Colorado River and Rio Grande such as the Pecos, Devils, and South Llano rivers. Flow in these rivers and streams is critical to the Plateau Region in that it provides municipal drinking water, supplies irrigation and livestock needs, maintains environmental habitats, and supports a thriving ecological and recreational tourist economy. Water users downstream of the Plateau Region (Regions K, L, and M) likewise have a stake in maintaining and protecting river flows.

Although rather limited during severe drought conditions, surface-water supplies in the Region are important (Figure ES-5). The Cities of Kerrville and Del Rio currently use surface water from the Guadalupe River and from San Felipe Springs, respectively. Camp Wood in Real County is supplied from Old Faithful Spring located on a tributary to the Nueces River. For surface-water supplies, drought-of-record conditions relate to the quantity of water available to meet existing permits from the Rio Grande, Nueces, Colorado, Guadalupe, and San Antonio rivers and their tributaries as estimated by Run 3 of the TCEQ Water Availability Models (WAMs).

Water recycling, or reuse, is reusing treated wastewater for beneficial purposes such as agricultural and landscape irrigation or industrial processes, and potentially for public consumption. The Cities of Kerrville and Camp Wood have active water reuse programs.

The PWPG recognizes the important ecological water supply function that all springs perform in the Region. Springs create and maintain base flow to rivers, contribute to the esthetic and recreational value of land, and are significant sources of water for wild game and aquatic species. Water issuing from springs forms wetlands that attract migratory birds and other fowl that inhabit the Region throughout the year. The spring wetlands host numerous terrestrial and aquatic species, some of which are recognized as threatened and endangered.

The PWPG has identified three “Major Springs” that are important for their municipal water supply contribution. The fourth largest spring system in Texas, San Felipe Springs, discharges to San Felipe Creek east of Del Rio and provides municipal drinking water for the City, as well as irrigation use downstream. Las Moras Springs in Kinney County is of historical significance for its importance as a supply source on early travel routes and military fortifications. Today, Las Moras Springs supports the

Fort Clark Springs community and is hydrologically associated with the same aquifer system that serves Fort Clark Springs MUD and the City of Brackettville. The third major spring is Old Faithful in Real County, which is the drinking-water supply source for the City of Camp Wood. Although only three springs are identified as "Major Springs", the PWPG recognizes that all springs in the Region are important and are deserving of natural resource protection.

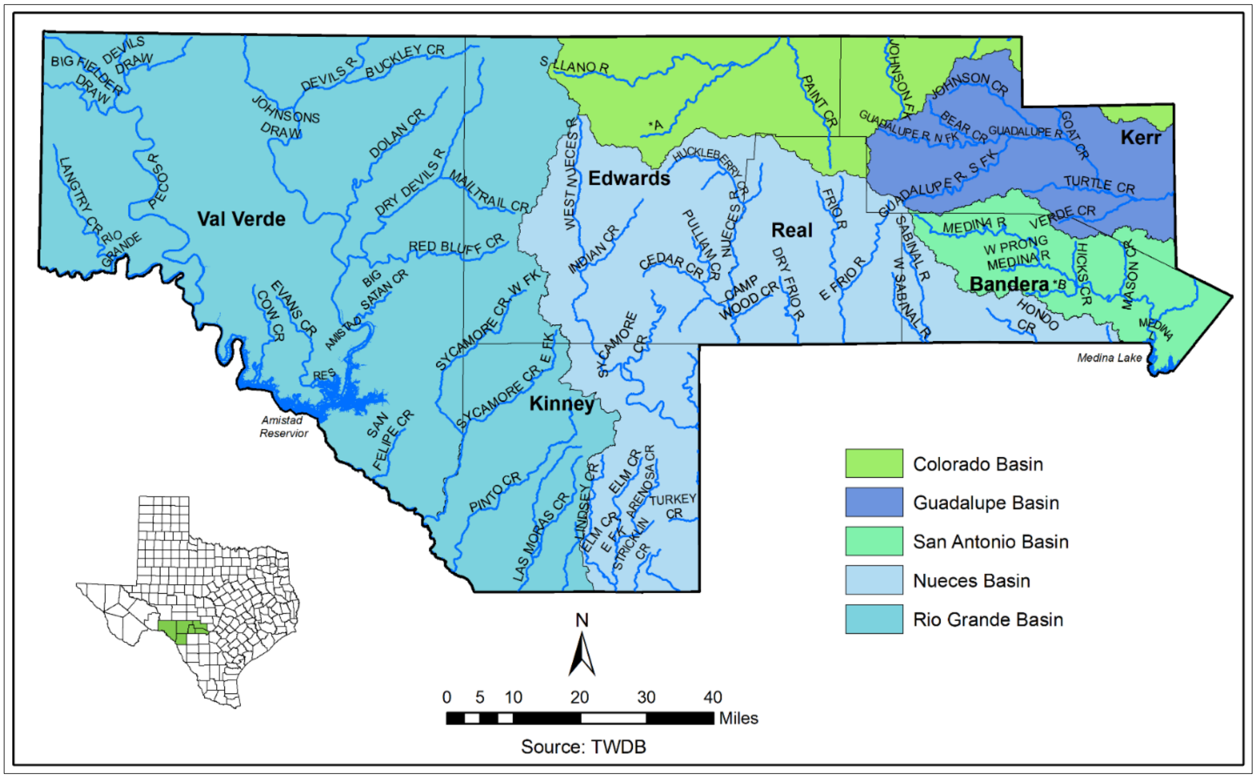

Figure ES-5. Surface Water Sources

WATER MANAGEMENT STRATEGIES

A major component of this *Plan* is to identify municipalities and water-use categories that may, in times of severe drought, be unable to meet expected water-supply needs based on today's ability to access, treat, and distribute the supply. Recommended alternatives, or water management strategies, to meet anticipated drought-induced shortages are presented for consideration. It should be acknowledged that the PWPG has no authority to mandate that any recommended strategy be implemented, and that it is the individual entity's initiative to act on needed changes.

Tables represented within the Executive Summary Appendix (TWDB Water Planning Data Reports) list projected water supply shortages within the Region under drought-of-record conditions based on no new infrastructure development, along with a secondary water needs analysis for all water user groups and wholesale water providers for which conservation or direct reuse water management strategies are recommended. The secondary water needs analysis calculates the water needs that would remain after assuming all recommended conservation and reuse water management strategies are fully implemented. Additional tables provide a listing of all recommended (65) and alternative (5) water management strategies in this *Plan* that if implemented may assist in meeting supply shortages. Additional strategies are recommended for other entities that have no projected supply shortage but have desired projects to be considered for funding. Conservation and water-loss strategies are also recommended where appropriate. Total capital cost to implement the recommended strategies is $515,667,573.

A goal of this *Plan* is to provide for the health, safety, and welfare of the human community, with as little detrimental effect to the environment as possible. Recreation activities involve human interaction with the outdoor environment and are often directly dependent on water resources. It is recognized that the maintenance of the regional environmental community's water supply needs serves to enhance the lives of citizens of the Plateau Region as well as the tens of thousands of annual visitors to this Region.

The implementation of water management strategies recommended in Chapter 5 of this *Plan* is not expected to have any impact on native water quality. Primary and secondary safe drinking water standards, which are the key parameters of water quality identified by the PWPG as important to the use of the water resource, are not compromised by the implementation of the strategies. Also, no recommended strategies involve moving water from a rural location for use in an urban area.

WATER QUALITY

Water quality plays an important role in determining the suitability of water supplies to meet current and future water needs. Primary and secondary safe drinking water standards are the key parameters of water quality identified by the PWPG as important to the use of water resources and are used for comparisons of water quality data. The reservoirs within the Plateau Region - Amistad Reservoir and Medina Lake - are some of the clearest (most transparent) water bodies in the State of Texas. Amistad Reservoir is the third clearest water body in Texas and Medina Lake is the fifth clearest.

Groundwater resources in the Plateau Region are generally potable, although between five and 10 percent of the groundwater is brackish. Groundwater quality problems are generally related to naturally high concentrations of total dissolved solids (TDS) or to the occurrence of elevated concentrations of individual dissolved constituents. High concentrations of TDS are primarily the result of the lack of sufficient recharge and restricted circulation. Together, these retard the flushing action of fresh water moving through the aquifers.

Water quality is generally good throughout the Plateau Region; however, a few specific water quality issues are of concern.

- Increase in urban runoff generally comes with an increase in impervious cover in populated areas. Urbanization also causes increased pollutant loads, including sediment, chemicals from motor vehicles, pesticides/herbicides/fertilizers from gardens and lawns, viruses/bacteria/ nutrients from human and animal wastes including septic systems, heavy metals from a variety of sources, and higher temperatures of the runoff.
- Increasing population has also manifested itself in the fragmentation of larger properties. With the advent of fragmentation comes the proliferation of new wells being drilled to serve individual properties. Each new well thus becomes another potential conduit for surface contamination to reach the underlying aquifer system.
- Vehicular traffic in streambeds disrupts streamflow, damages plants and animals living in these areas, damages channels and erodes banks, and decreases water quality by increasing the turbidity of the water in these rivers and streams.
- The constituent of most concern is nitrate, which was found above the primary maximum contaminant level in several water-sample analyses from the Edwards (BFZ) Aquifer and the Austin Chalk Aquifer in Kinney County. Historically, the primary contribution to poor groundwater quality occurs in wells that do not have adequately cemented casing.
- Poorer groundwater quality in the Region is generally from two sources, evaporite beds in the Glen Rose limestone and from surface contamination, both of which can be prevented by proper well construction. Also of concern are above normal levels of radioactivity that have been detected in sand sequences of the Glen Rose and Hensell Formations.

WATER CONSERVATION AND DROUGHT CONTINGENCY

Water conservation and drought contingency planning are two of the most important components of water supply management. Recognizing their potential contribution, setting realistic goals, and aggressively enforcing their implementation may significantly extend the time when new supplies and associated infrastructure are needed. Water conservation are those practices, techniques, programs, and technologies that will protect water resources, reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or increase the recycling or reuse of water so that a water supply is made available for future or alternative uses. Water conservation strategies and recommendations are discussed in Chapter 5, Section 5.3.

Although residents of the Plateau Region are generally accustomed to highly variable climatic conditions, the relatively low rainfall and the accompanying high levels of evaporation underscore the necessity of developing plans that respond to potential disruptions in the supply of groundwater and surface water caused by drought conditions.

Drought contingency plans provide a structured response that is intended to minimize the damaging effects caused by water shortage conditions. A common feature of drought contingency plans is a structure that allows increasingly stringent drought response measures to be implemented in successive stages as water supply or water demand conditions intensify. This measured or gradual approach allows for timely and appropriate action as a water shortage develops. The onset and termination of each implementation stage should be defined by specific "triggering" criteria. Triggering criteria are intended to ensure that timely action is taken in response to a developing situation and that the response is appropriate to the level of severity of the situation. Chapter 7 provides a detailed discussion on drought impact and preparedness in the Plateau Region.

PROTECTION OF WATER, AGRICULTURAL AND NATURAL RESOURCES

The long-term protection of the Plateau Region's water resources, agricultural resources, and natural resources is an important component of this *2026* update of the *Plateau Region Water Plan*. Long-term water resources protection occurs in the conservative methodology of estimating water supply availability, evaluation of water management strategies for potential threats to water resources, the recommendation of water conservation strategies, and regional recommendations pertaining to water conservation and drought management practices. When enacted, the conservation practices will diminish water demand, the drought management practices will extend supplies over stress periods, and land management practices (land stewardship) will potentially increase aquifer recharge and stream base flow conditions.

Agricultural resources are protected in this *Plan*. There is no current movement of water from agricultural areas in the Region for use in urban areas; and there are no recommended strategies in this *Plan* that involve moving water from rural locations. Also, non-agricultural strategies include an analysis of potential impact to agricultural interests.

The protection of natural resources as intended in this *Plan* is closely linked with the protection of water resources as discussed above. The methodology adopted to assess groundwater source availability is based on not significantly impacting spring flows that contribute to base flows in area rivers. Thus, the intention to protect surface flows is directly related to those natural resources that are dependent on surface water sources for their existence.

Environmental impacts were evaluated in the consideration of strategies to meet water-supply deficits. Of prime consideration was whether a strategy potentially could diminish the quantity of water currently existing in the natural environment and if a strategy could impact water quality to a level that would be detrimental to animals and plants that naturally inhabit the area under consideration. Although no specific "ecologically unique river and stream segments" are recommended in this *Plan*, the PWPG is very explicit in acknowledging the importance of all springs and stream segments for their significance as wildlife habitat.

POLICY RECOMMENDATIONS

Water-supply resources intended to meet the future needs of all water-use categories in the Plateau Region are recognized to be limited in comparison to resources available in many other parts of the State. A conscientious effort to maintain an awareness of existing conditions and anticipate future water needs is recognized by the PWPG as being the foundation of continued regional water planning. In support of this belief, the PWPG is providing specific recommendations in this *Plan* that address:

- Water conservation.
- Water management.
- Water planning.
- Water research needs.
- Consideration of ecologically unique river and stream segments.
- Consideration of unique sites for reservoir construction.

The PWPG encourages the continued public process of developing region-based water plans. Copies of the *2026 Plateau Region Water Plan* are accessible in county courthouses, public libraries, and through the PWPG website. The *Plan* is also accessible through the Texas Water Development Board website.

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EXECUTIVE SUMMARY APPENDIX - TWDB WATER PLANNING DATA REPORTS

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- Water User Group (WUG) Population.
- WUG Demand.
- Source Availability.
- WUG Existing Water Supply.
- WUG Needs / Surplus.
- WUG Second-Tier Identified Water Needs.
- WUG Data Comparison to 2021 Regional Water Plan.
- Source Data Comparison to 2021 Regional Water Plan.
- WUG Unmet Needs.
- Recommended WUG Water Management Strategies.
- Recommended Projects Associated with Water Management Strategies.
- Alternative WUG Water Management Strategies.
- Alternative Projects Associated with Water Management Strategies.
- WUG Management Supply Factor.
- Recommended Water Management Strategy Supply Associated with a New or Amended Inter-Basin Transfer Permit *(No relevant data for the Plateau Region).*
- WUG Recommended WMS Supply Associated with a New or Amended Inter-Basin Transfer Permit and Total Recommended Conservation WMS Supply *(No relevant data for the Plateau Region).*
- Sponsored Recommended WMS Supplies Unallocated to WUGs *(No relevant data for the Plateau Region).*
- Major Water Provider (MWP) Existing Sales and Transfers.
- Major Water Provider (MWP) Water Management Strategy Summary.

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CHAPTER 1
PLATEAU REGION DESCRIPTION

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1 PLATEAU REGION

Located along the southern boundary of the Texas Edwards Plateau, the six-county Plateau Water Planning Region (PWPG) stretches from the Central Texas Hill Country westward to the Rio Grande (Figure 1-1). Under land grants issued by Mexico and later by the Republic of Texas in the early 1800s, European immigrants (predominantly German) and transient settlers from the southern United States colonized this rugged land formally occupied for centuries by citizens of Mexico and Native Americans. These immigrants and those to follow settled small towns along many of the spring-fed streams that crossed the area and from these way stations spread out to establish farms and ranches throughout the Region. Even today, the area retains much of its original cowboy frontier and German and Hispanic heritage. Chapter 1 that follows is a broad introduction to this Region and the water supply challenges it faces. The Region's economic health and quality of life concerns, including the aquatic environment and recreational opportunities, are dependent on a sustainable water supply that is equitably managed.

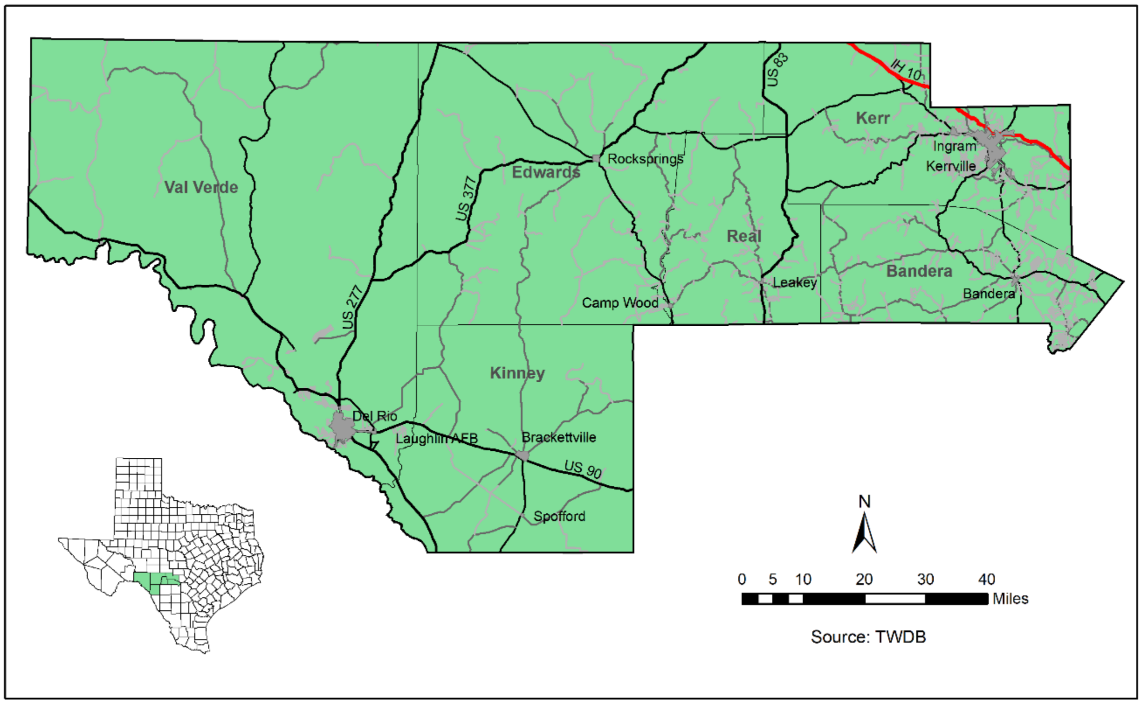

Figure 1-1. Location of the Plateau Region

1.1 WATER PLANNING AND MANAGEMENT

1.1.1 Regional Water Planning

In January of 2021, the fifth round of regional water planning was concluded with the adoption of the *2021 Plateau Region Water Plan* (*Plan*). It is understood that this *Plan* is not a static plan but rather is intended to be revised as conditions change. For this reason, the *Plan* put forth in this document is not a new *Plan*, but rather an evolutionary modification of preceding *Plans (2001, 2006, 2011, 2016 and 2021)*. Only those parts of the previous *2021 Plan* that required updating, and there were many, have been revised.

The purpose of the *2026 Plateau Region Water Plan* is to provide a document that water planners and users can reference for long and short-term water management recommendations. Equally important, this *Plan* serves as an educational tool to enlighten all citizens as to the importance of properly managing and conserving the delicate water resources of this pristine Region. Chapter 1 presents a broad overview of the Region and many of the key issues that must be addressed as part of any attempt to develop a comprehensive water management plan that is acceptable and beneficial to those who reside here.

The PWPG is a voluntary association comprised of voting and non-voting members who represent a minimum of 12 water-use categories. Since 1997, the PWPG has been involved in a wide range of projects, programs, and the development of the *Plateau Region Water Plan*.

The *2026 Plateau Region Water Plan* follows an identical format as the plans prepared by the other 15 water planning regions in the State as mandated by the Texas Legislature and overseen by the Texas Water Development Board (TWDB). The *Plan* provides an evaluation of current and future water demands for all water-use categories and evaluates water supplies available during drought-of-record conditions to meet those demands. Where future water demands exceed available supplies, management strategies are considered to meet the potential water shortages. Because our understanding of current and future water demand and supply sources are constantly changing, it is intended for this *Plan* to be revised every five years or sooner if deemed necessary.

During the fifth round of regional water planning, the 2021 Regional Water Plans and 2022 State Water Plan were modified to be aligned with water utility service areas, rather than political boundaries, such as city limits. This was due to TWDB rule revisions, that now define a municipal water-user group (WUG) as being utility based. Some cities that were once included in the 2016 and older regional water plans are not represented in the 2021 and 2026 Plans because they do not have their own water and therefore no longer meet the TWDB WUG definition. For these entities, their population is represented through: (1) utility WUGs who provide water for them and meet the new WUG definition, or (2) county-other WUGs as aggregated rural population.

In the development of this *Plan,* it was essential to coordinate planning efforts with adjacent regions (Regions E, F, K, L, and M) to ensure that there were no conflicting strategies pertaining to shared or transferred water-supply sources. This coordination resulted in there being no known conflicts between this *Plan* and plans prepared for other regions.

Water-supply availability under drought-of-record conditions is considered in the planning process to ensure that water demands can be met under the worst of circumstances. Recommendations of the Drought Preparedness Council are considered in this *Plan*.

For surface water supplies, drought-of-record conditions relate to the quantity of water available to meet existing permits from the Rio Grande, Nueces, Colorado, Guadalupe, and San Antonio rivers and their tributaries as estimated by the Full Authorization Run (Run 3) of the Texas Commission on Environmental Quality (TCEQ) - Water Availability Models (WAM). For this *Plan,* the assessment of surface water availability reflects updates representing new and / or amended water rights along with current operating policies and / or contractual agreements. The *2026 Pan* has no impact on navigation on surface water courses.

The availability of groundwater during drought-of-record conditions is based primarily on modeled available groundwater (MAG) declarations that may be produced on an average annual basis to achieve a desired future condition (DFC) as adopted by Groundwater Management Areas (GMAs) (per Texas Water Code §36.001). Groundwater availability volumes for parts of the Region where MAGs are not determined by the TWDB are calculated separately. The GMA process is described in greater detail in Section 1.1.6 of this chapter. Chapter 3 contains a detailed analysis of water-supply availability in the Region.

This *Plan* continues to benefit from environmental data on the more prominent watercourses in the Region as provided by the Texas Parks and Wildlife Department (TPWD). This data was useful in the assessment and consideration of environmental flow needs, springs, and ecologically significant stream segments.

This *2026 Plateau Region Water Plan* fully recognizes and protects existing water rights, water contracts, and option agreements. The PWPG strongly encourages all entities to participate in the planning process so that their specific concerns can be recognized and addressed. The PWPG also encourages the participation of Groundwater Conservation Districts (GCDs) and recognizes their management plans and rules.

Water quality is recognized as an important component in this 50-year water plan. Water supplies can be diminished or made more costly for their intended use if water quality is compromised. To ensure that this *Plan* fully considers water quality, the Federal Clean Water Act and the State Clean Rivers Program were reviewed and considered when developing water-supply availability estimates (Chapter 3), water management strategies and water quality impacts (Chapter 5), and policy recommendations (Chapter 8).

Also, considered in the above segments of the *Plan* were the Water Quality Management Plans (WQMPs) of TCEQ and the Texas State Soil and Water Conservation Board (TSSWCB). TCEQ's WQMP is tied to the State's water quality assessments that identify and direct planning for implementation measures that control and / or prevent priority water quality problems. Elements contained in the WQMP include effluent limitations of wastewater facilities, total maximum daily loads, nonpoint source management controls, identification of designated management agencies, and groundwater and source water protection planning. TSSWCB's WQMP is a site-specific plan developed through and approved by Soil and Water Conservation Districts for agricultural or silvicultural lands. The plan includes appropriate land treatment practices, production practices, management measures, and technologies.

In the year 2020, the U.S. Census Bureau performed a census count, which provides the base year for future population projections in the Region. Although the PWPG accepts the 2020 census count, to include the TWDB approved revision requests provided by the water utilities, members express concern that the census does not recognize the significant seasonal population increase that occurs in these counties, as the area draws large numbers of hunters and recreational visitors, as well as absentee landowners who maintain vacation, retirement, and hunting homes and cabins. Therefore, an emphasis is being made in this planning document, especially in the rural counties, to recognize a need for more water than is justified simply from the population-derived water demand quantities.

1.1.2 Interim Planning Project Reports

Previous planning periods included interim projects designated by the PWPG to evaluate specific water-supply availability and management issues (Table 1-1). These reports can be accessed on the Upper Guadalupe River Authority (UGRA) website.

Table 1-1. Interim Planning Project Reports

Interim Planning Project Reports	Date
Groundwater Resources of the Edwards Aquifer in the Del Rio Area, Texas	2001
The Lower Trinity Aquifer of Bandera and Kerr Counties, Texas	2001
Springs of Kinney and Val Verde Counties	2005
Spring Flow Contribution to the Headwaters of the Guadalupe River in Western Kerr County, Texas	2005
Installation of Groundwater Monitoring Equipment in Designated Wells in the Plateau Planning Region	2005
Water Rights Analysis and ASR Feasibility in Kerr County	2009
ASR Feasibility in Bandera County	2009
Groundwater Data Acquisition in Edwards, Kinney and Val Verde Counties, Texas	2010
Water Use by Livestock and Game Animals in the Plateau Regional Water Planning Area	2010
Occurrence of Significant River Alluvium Aquifers in the Plateau Region	2010

1.1.3 State Water Plan

The TWDB adopted Water for Texas 2022 as the latest official State Water Plan of Texas. The Texas Water Code directs the TWDB to periodically update this comprehensive water plan, which is used as a guide to State water policy. The 2022 State Water Plan is the fifth water plan to incorporate water management and policy decisions made at the regional level as expressed in the 16 approved regional water plans.

1.1.4 Local Water Management Plans

The Plateau Region often experiences periods of limited rainfall, especially compared with more humid areas in the eastern part of the State. Although residents of the Region are generally accustomed to these conditions, the low rainfall and accompanying high evaporation underscore the necessity of developing plans to manage resources responsibly and to respond to potential disruptions in the supply of groundwater and surface water caused by drought conditions.

The following entities have developed water management and drought contingency plans:

- City of Del Rio.
- City of Brackettville.
- City of Kerrville.
- City of Bandera.
- City of Leakey.
- City of Camp Wood.
- Fort Clark Municipal Utility District.
- Aqua Texas.
- Headwaters GCD.
- Bandera County River Authority and Groundwater District.
- Kinney County GCD.
- Real-Edwards Conservation and Reclamation District.

1.1.5 Groundwater Conservation Districts

The Texas Legislature has established a process for local management of groundwater resources through GCDs, which are charged with managing groundwater by providing for the conservation, preservation, protection, recharging, and prevention of waste of groundwater within their jurisdictions. An elected or appointed board governs these districts and establishes rules, programs, and activities specifically designed to address local problems and opportunities. Texas Water Code §36.0015 states in part, "Groundwater Conservation Districts created as provided by this chapter are the State's preferred method of groundwater management." Four districts are currently in operation within the Plateau Region (Figure 1-2); their management goals are discussed in further detail in Chapter 6.

- Bandera County River Authority and Groundwater District.
- Headwaters GCD.
- Real-Edwards Conservation and Reclamation District.
- Kinney County GCD.

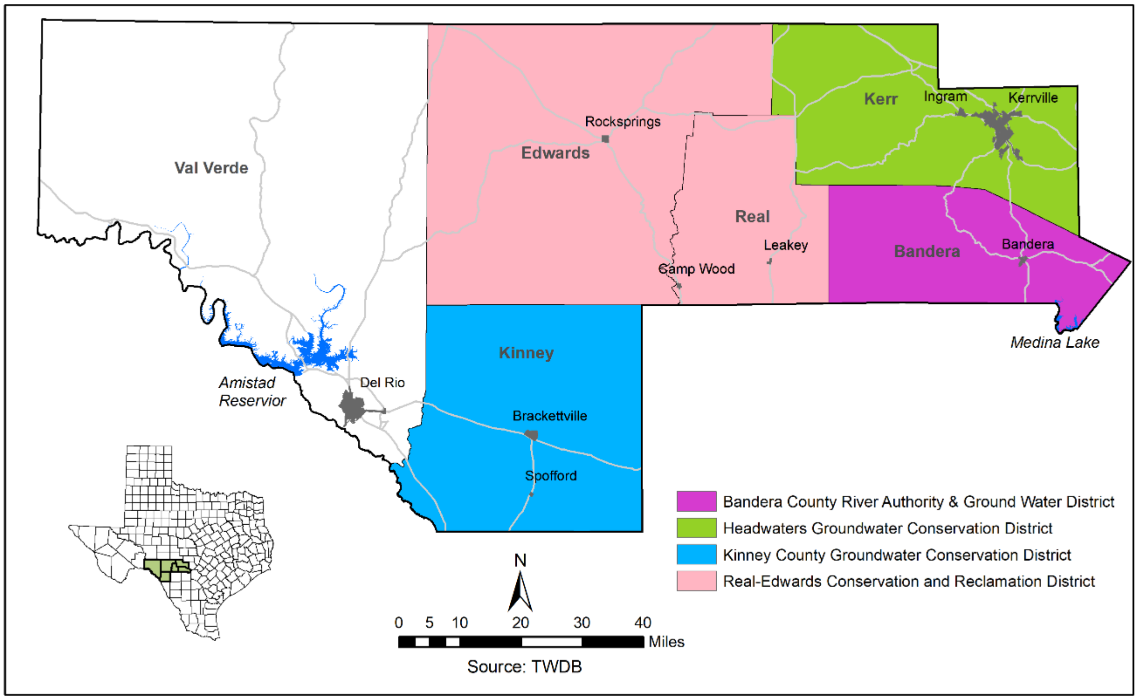

Figure 1-2. Groundwater Conservation Districts

1.1.6 Groundwater Management Areas

In previous sessions, the Texas Legislature has redefined the way groundwater is to be managed. GMAs were created in order to provide for the conservation, preservation, protection, recharging, and prevention of waste of the groundwater, and of groundwater reservoirs or their subdivisions, and to control subsidence caused by withdrawal of water from those groundwater reservoirs or their subdivisions. Senate Bill 2 of the 77th Texas Legislature (2001) authorized:

- The TWDB to designate GMAs that would include all major and minor aquifers of the State.
- Required GCDs to share groundwater plans with other districts in the GMA.
- Allowed a GCD to call for joint planning among districts in a GMA.

The objective was to delineate areas considered suitable for management of groundwater resources. A GMA should ideally coincide with the boundaries of a groundwater reservoir (aquifer) or a subdivision of a groundwater reservoir, but it may also be defined by other factors, including the boundaries of political subdivisions. In December 2002, the TWDB designated 16 GMAs covering the entire State.

In 2005, the Legislature once again changed the direction of groundwater management. The new requirements, codified in Texas Water Code Chapter 36.108, required joint planning in management areas among GCDs. The new requirements direct that,

> ***"Not later than September 1, 2010, and every five years thereafter, the districts shall consider groundwater availability models and other data or information for the management area and shall establish desired future conditions for the relevant aquifers within the management area."***

DFCs, as described in Title 31, Part 10, §356.10 (6) of the Texas Administrative Code (TAC) are "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 GCDs within a GMA as part of the joint planning process." This description is a precursor to developing a volumetric number called MAG. The TWDB is responsible for providing each GCD and Regional Water Planning Group (RWPG), located wholly or partly in the management area, with MAG volumes for each specified aquifer. Once the MAG is determined, the districts begin issuing groundwater withdrawal permits to support the DFC of the aquifer up to the total amount of the MAG. These permits express DFCs by only allowing withdrawals that will support the conditions established by the GMA. Regional water plans must also incorporate the MAG for each aquifer within their regions. GMA DFCs are thus recognized as the conservative means of sustainably preserving groundwater supplies for use by future generations. The counties of the Plateau Region are included in three GMAs:

- GMA 7 includes Edwards, Kinney (partial), Real and Val Verde.
- GMA 9 includes Bandera and Kerr.
- GMA 10 includes Kinney (partial).

DFCs have been adopted for specified aquifers in these GMAs, and, therefore, this *2026 Plateau Region Water Plan* includes a revision to all groundwater source availability estimates based on MAG volumes generated from the GMA process. According to the approved DFCs, MAG volumes within Kerr County associated with the Edwards-Trinity (Plateau) Aquifer changed significantly for the sixth cycle of regional water planning. Total groundwater availability is the sum of both the MAG and non-MAG volumes for a particular aquifer.

1.1.7 Hill Country Priority Groundwater Management Area

A portion of the Plateau Region (Bandera and Kerr Counties) is included in the initial Hill Country Priority Groundwater Management Area (PGMA). The PGMA process is initiated by the TCEQ, who designates a PGMA when an area is experiencing critical groundwater problems or is expected to do so within 25-years. These problems include shortages of surface water or groundwater, land subsidence resulting from groundwater withdrawal, or contamination of groundwater supplies. Once an area is designated a PGMA, landowners have two years to create a GCD. Otherwise, the TCEQ is required to create a GCD or to recommend that the area be added to an existing district. The TWDB works with the TCEQ to produce a legislative report every two years on the status of PGMAs in the State. The PGMA process is completely independent of the current GMA process and each process has different goals. The goal of the PGMA process is to establish GCDs in these designated areas so that there will be a management entity to address the identified groundwater issues. PGMAs are still relevant if there remain portions within these designated areas without GCDs. The Plateau Region's portion of the Hill Country PGMA (Bandera and Kerr Counties) has established GCDs. A statewide map of the declared PGMA areas is available on the TWDB’s website and is called Priority Groundwater Management Areas.

1.2 REGIONAL GEOGRAPHIC SETTING

1.2.1 Plateau Region

The Plateau Region encompasses six counties in the west-central part of the State of Texas, stretching from the headwaters of the Guadalupe and San Antonio rivers in the Central Texas Hill Country westward to Del Rio and the Rio Grande international border (Figure 1-1). With a total area of 9,252 square miles (mi^2), the Plateau Region represents 3.5 percent of the total area of the State and includes the counties of Bandera (792 mi^2), Edwards (2,120 mi^2), Kerr (1,106 mi^2), Kinney (1,364 mi^2), Real (700 mi^2), and Val Verde (3,171mi^2).

1.2.2 Physiography

The Plateau Region lies along the southern edge of the Edwards Plateau and is bounded on the east by the Central Texas Hill Country and on the west by the Rio Grande international border. The Balcones escarpment generally forms the southern boundary of the Plateau Region. The escarpment is a steep topographic feature that traces the path of a major fault system that was active more than 10 million years ago. The escarpment separates the more resistant rocks of the Edwards Plateau to the north from softer and more easily erodible rocks to the south. Erosion by streams has cut steep canyons into the thick limestone beds of the Edwards Plateau.

Its rolling prairies, steep canyons, and the large number of spring-fed perennially flowing streams characterize the Region. The uplands are fairly level, but the landscape of the stream valleys is very hilly with steep canyons that provide rapid drainage. Upland soils are dark alkaline clays and clay loams; the river valley soils are gravelly and light colored. Some cultivation takes place in the deep, dark-gray, or brown loams and clays of the river bottoms and, over the broad flat farming belt of Kinney County. The major soil management concerns are brush control, low fertility, and excess lime.

1.2.3 Population and Regional Economy

The projected year 2030 population in the Plateau Region of 140,468 results in a population density of 15.3 people per square mile, which is much less than the State average of 72 people per square mile. The regional population is projected to grow by 10 percent to 154,530 by 2080. Approximately 50 percent of the total population of the Region is in the two largest cities, Del Rio / Laughlin AFB (37,572) and Kerrville (33,038). The projected year 2030 populations of other major communities in the Region are: Brackettville and Fort Clark Springs (2,449); Bandera (1,949); Rocksprings (666); Camp Wood (339); and Leakey (210) (Figure 1-3). These population estimates do not include a significant transient (tourist, hunting, recreation, etc.) population that has a resulting significant impact on overall water-supply demand in the Region. Current and projected future population of the Region are discussed in detail in Chapter 2.

The Regional economy is based primarily on tourism, hunting, ranching agribusiness, and government. The beauty of the Hill Country, the solitude of the forested canyons and plateau grasslands, and the gateway to Mexico all support a major tourist trade. Agribusiness is predominantly associated with the raising of sheep, goats, beef cattle, and exotic game throughout the Region.

Apple orchards in Bandera County; oil and gas production and mohair production in Edwards and Real Counties; medical services and manufacturing in Kerr County; irrigated cotton, hay, and wheat in Kinney County; and a military base and trade with Mexico in Val Verde County all contribute largely to the Region's overall economy.

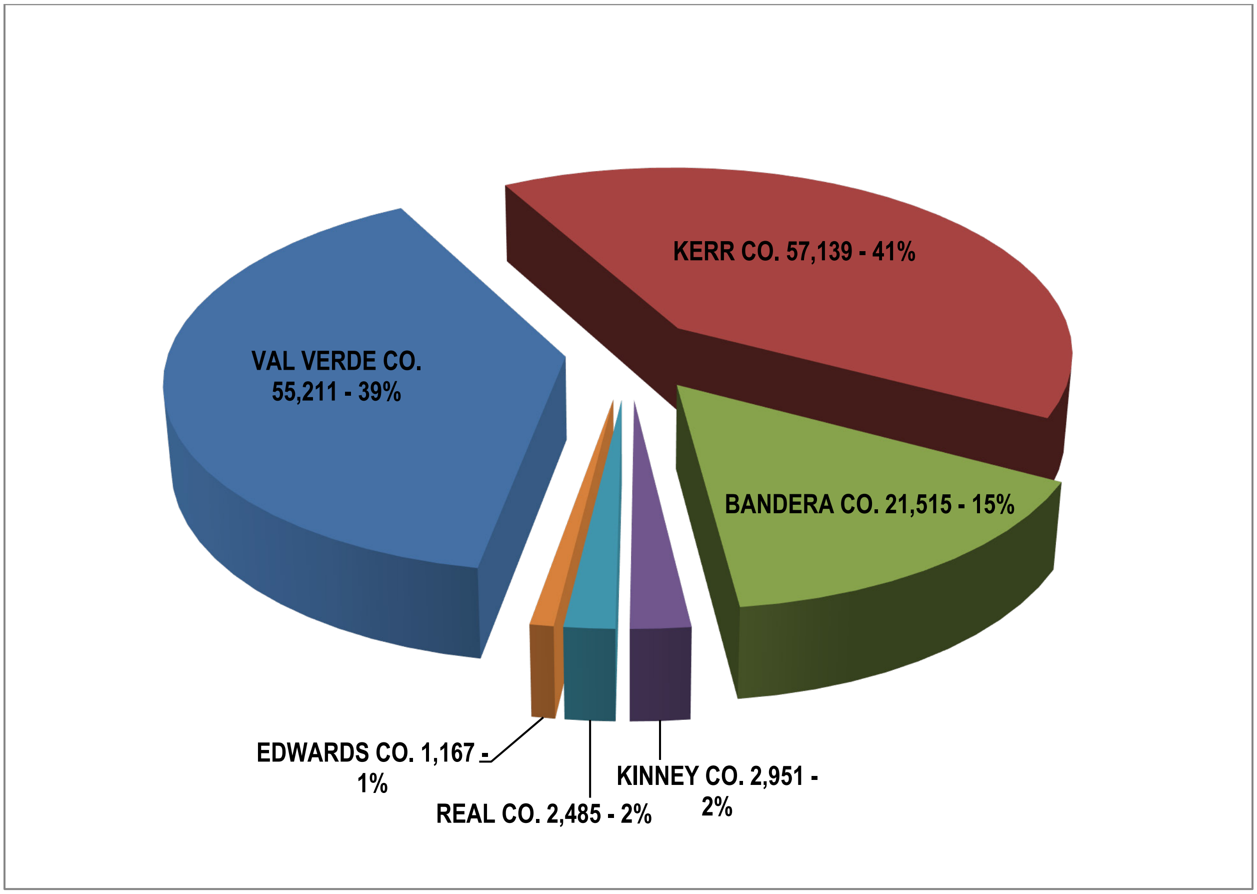

Figure 1-3. Year 2030 Projected Population

1.2.4 Land Use

Land use in the six-county Region is divided into seven categories (Figure 1-4):

- Urban (or developed).
- Agricultural (cultivated).
- Rangeland.
- Forest.
- Grassland.
- Wetlands.
- Barren Land.
- Shrubland / scrubland.

Urban lands are the location of cities and towns that make up less than one percent of the Region's total land area. Agricultural lands are identified as areas that support the cultivation of crops. These lands, which potentially involve extensive irrigation, also occupy less than one percent of the Region. Together, urban and agricultural lands comprise the two most significant areas of water consumption in the Plateau Region.

Rangeland is defined as all areas that are either associated with or are suitable for livestock production. Although this is the largest category of land use in areal extent in the Region, rangeland accounts for one of the smallest sources of water demand. Forestland is limited to areas where topography and climate support the growth of native trees. Grasslands are areas characterized as having vegetation dominated by grasses, usually found in a semi-arid climate. Rainfall and soils are insufficient to support significant tree growth. Areas designated as either water or wetlands are associated with the rivers and their tributaries. Barren lands are defined as undeveloped areas with little potential for use as agricultural land, rangeland, or forestland. Shrubland and / or scrubland is a plant community characterized by vegetation dominated by shrubs, often also including grasses, herbs, and geophytes.

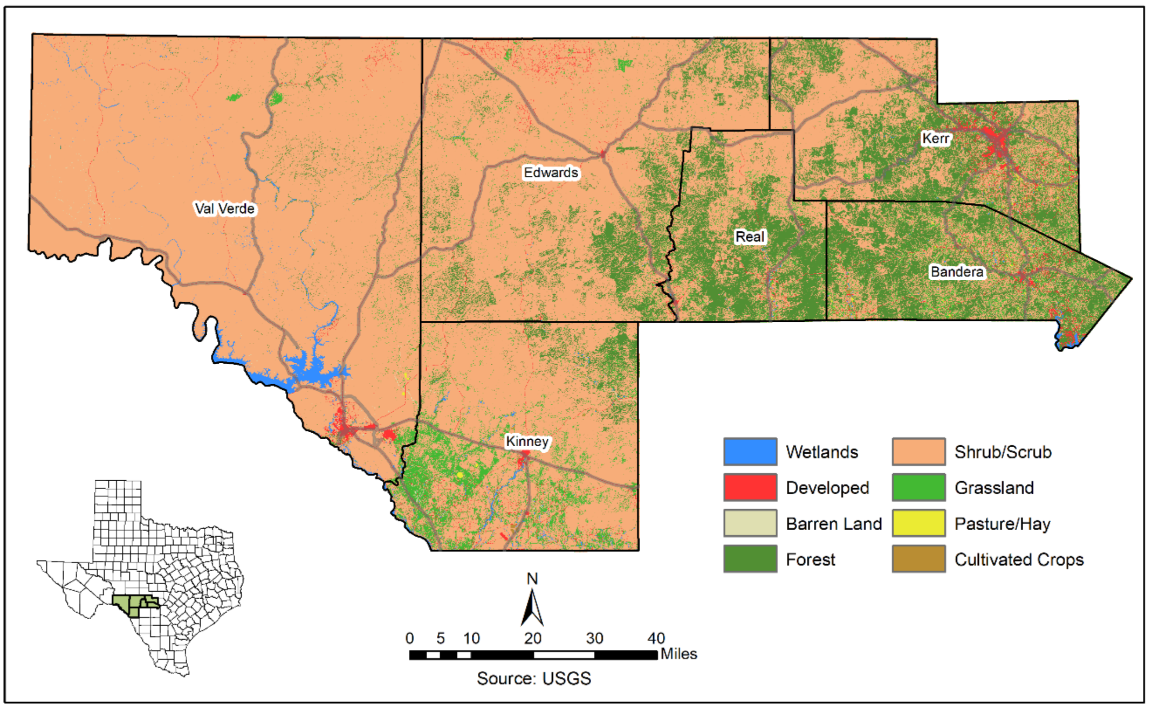

Figure 1-4. Land Use

1.2.5 Climate and Drought

The climate of the Plateau Region is semi-arid to arid as precipitation decreases westward across the Region. The average precipitation for the Edwards Plateau is 25 inches. Figure 1-5 illustrates the variability with respect to the six counties of the Region with precipitation decreasing from approximately 35 inches in the easternmost reaches of Bandera and Kerr Counties to less than 17 inches in western Val Verde County (National Weather Service). Net lake evaporation (Figure 1-6) increases from 58 inches in Bandera and Kerr Counties to about 78 inches in western Val Verde County (TWDB). Net lake evaporation is the difference between total evaporation from a lake and total precipitation. Figure 1-7 illustrates average monthly rainfall recorded at selected stations.

Long periods of below normal rainfall may have severe impacts on groundwater recharge, spring flow, and stream flow. Under these conditions, the lack of rainfall leads to reduced recharge to aquifers and to lower water levels in wells. As water levels fall in aquifers in drought-stricken areas, the volume of water discharging from important water supply related springs may diminish to the point that communities reliant on spring water, such as Camp Wood in Real County, may experience an insufficient water supply to meet their full needs. Landowners who are dependent on spring-fed stream flow may also find insufficient volumes of surface water needed to support irrigation or other farming and ranching activities. The direct linkage between precipitation and water levels in aquifers of the Plateau Region is indicated by hydrograph records of wells that show rapid rises in water levels as a response to local rainstorms.

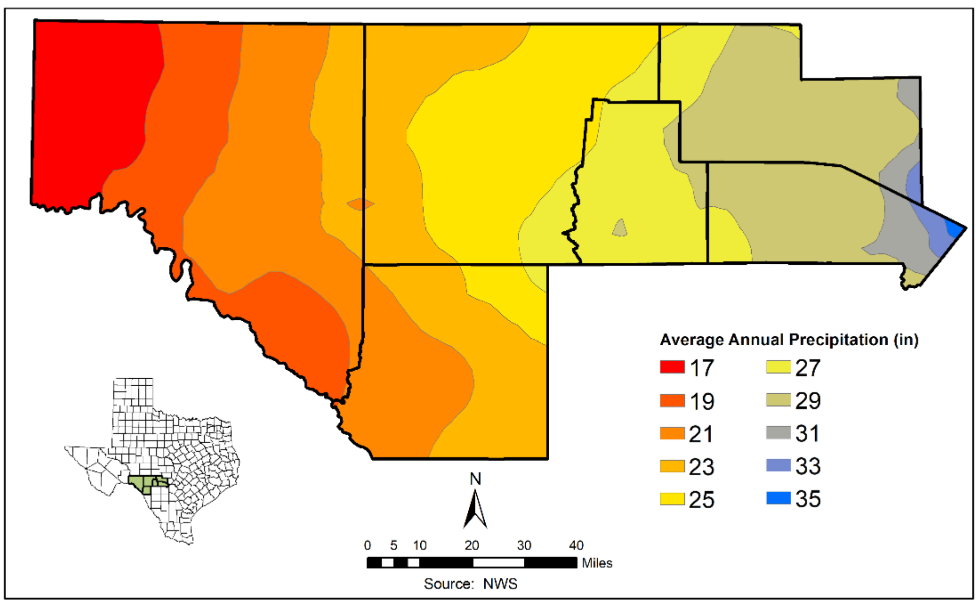

Figure 1-5. Variation of Precipitation

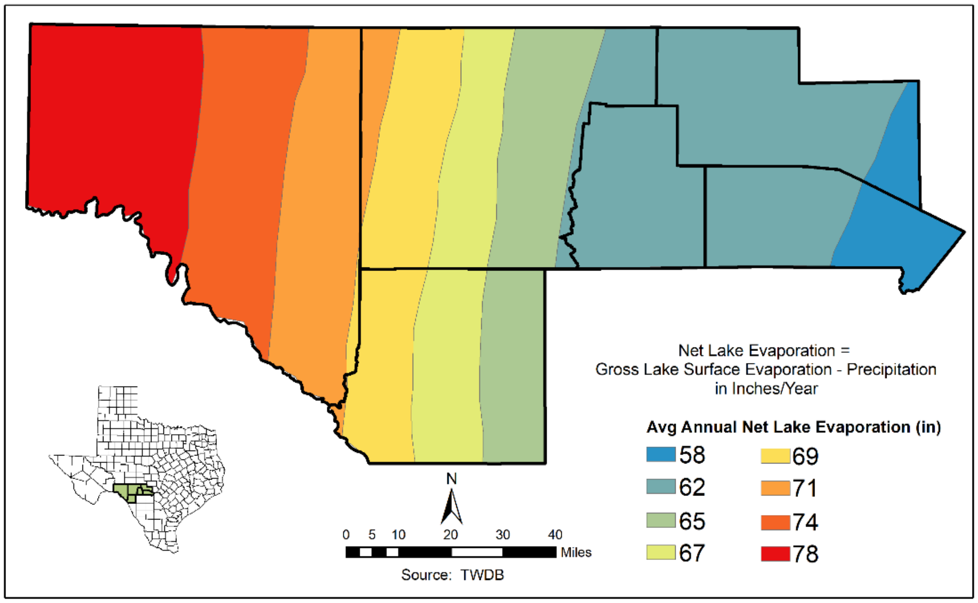

Figure 1-6. Net Lake Evaporation

Past climatic precipitation data was collected from the [National Oceanic and Atmospheric Administration], for the purposes of calculating average monthly rainfall (1993-2023) for a total of six weather stations within the Region. These selected stations not only meet the 30-year record of service requirement, but accurately represent the average monthly rainfall amounts for each county. Tables 1-2 through 1-6 present monthly rainfall amounts by county, in inches based on these 31-year averages. From highest to lowest values, average annual rainfall by county is reported as follows:

- Real County = 27.6 inches
    - Prade Ranch, TX – USC00417232 (1993-2023).
- Kerr County = 26.5 inches
    - Harper 3 Ene, TX – USC00413954 (1993-2023).
- Edwards County = 20.7 inches
    - Rocksprings, TX – USC00417706 (1993-2023).
- Val Verde County = 19.2 inches
    - Del Rio International Airport, TX – USW00022010 (1993-2023).
- Kinney County = 16.2 inches
    - Brackettville, TX – USC00411007 (1993-2019).
    - Brackettville 0.1 NE, TX – US1TXKY0003 (2020-2023).

According to the [National Centers for Environmental Information], most rainfall occurs between the months of May and October, as indicated by a graph of average monthly rainfall for selected stations (Figure 1-7). Rainfall during the spring and summer months is dominated by widely scattered thunderstorms. Because of the convective nature of thunderstorms, the amount of spring and summer precipitation in the Region increases with elevation.

Table 1-2. Edwards County Monthly Rainfall (1993-2023) (inches)

Station Name	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Average Annual Rainfall
Rocksprings, TX USC00417706	1993	0.67	0.86	1.12	2.46	2.40	0.93	0.21	0.55	2.57	0.25	0.15	0.74	
	1994	1.32	0.21	1.84	0.90	5.81	2.58	1.36	3.20	3.61	2.81	n/a	4.07	
	1995	0.24	0.71	2.60	0.90	5.06	0.92	1.31	0.72	3.53	0.38	2.26	0.29	
	1996	0.00	0.26	0.18	1.36	1.15	0.50	0.14	2.70	4.66	8.80	2.75	2.78	
	1997	1.00	3.12	3.10	3.36	3.47	7.19	0.01	0.69	3.80	2.97	0.83	0.97	
	1998	1.77	1.23	2.53	0.00	1.67	2.50	0.00	13.12	2.15	2.93	3.63	0.73	
	1999	0.12	0.11	3.14	2.14	5.10	3.16	2.73	0.35	0.29	3.04	0.00	0.12	
	2000	0.22	0.54	0.57	1.97	3.12	5.03	0.62	0.23	3.76	14.50	7.00	1.36	
	2001	2.06	1.04	1.41	1.28	3.07	1.21	0.48	2.06	0.43	1.49	3.37	0.78	
	2002	1.17	0.30	0.53	1.42	0.74	0.00	n/a	n/a	n/a	n/a	n/a	n/a	
	2003	0.03	0.55	1.41	0.04	0.23	4.20	4.61	2.47	5.03	3.73	1.30	0.01	
	2004	1.40	1.43	3.58	5.73	2.89	6.56	1.47	4.55	5.00	3.26	6.94	0.54	
	2005	1.31	3.15	3.83	0.65	5.27	0.61	3.98	3.42	0.08	4.27	0.02	0.12	
	2006	0.34	0.39	1.00	0.82	1.60	2.58	0.12	3.57	2.47	4.07	0.04	0.82	
	2007	3.23	0.11	5.23	2.33	7.61	8.70	5.45	5.96	4.43	0.60	1.19	0.34	
	2008	0.14	0.29	2.10	1.68	0.73	0.76	1.59	2.68	1.67	0.56	0.02	0.05	
	2009	0.10	0.05	2.07	2.63	1.31	0.71	3.85	0.69	1.97	2.63	1.17	1.93	
	2010	3.20	2.30	1.72	3.79	4.87	0.32	3.35	2.28	2.64	0.17	0.00	0.22	
	2011	1.31	0.78	0.00	0.48	0.43	0.13	0.24	0.42	2.46	2.48	n/a	0.01	
	2012	0.00	0.00	n/a	1.74	1.74	0.00	n/a	n/a	n/a	n/a	0.41	0.14	
	2013	2.11	n/a	0.75	0.59	2.70	3.19	n/a	n/a	1.15	2.71	0.39	n/a	
	2014	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.62	0.27	
	2015	1.18	0.11	0.31	1.93	4.84	0.46	0.00	0.06	0.09	0.02	0.00	1.67	
	2016	0.35	0.49	2.55	2.42	4.53	0.98	1.32	1.94	8.26	0.01	1.61	1.48	
	2017	0.61	1.47	0.95	3.75	1.23	0.02	0.52	n/a	n/a	n/a	n/a	n/a	
	2018	0.03	2.91	0.16	0.58	2.66	0.02	1.56	2.77	5.90	16.75	0.03	2.02	
	2019	0.07	0.06	1.56	2.44	2.02	7.74	0.05	2.39	0.66	1.16	0.71	0.35	
	2020	1.45	0.54	4.17	0.75	1.74	1.36	1.66	0.90	5.64	0.27	0.10	1.44	
	2021	0.70	1.50	0.95	0.88	3.88	1.95	4.32	2.96	2.12	0.75	0.45	0.13	
	2022	0.11	0.16	0.00	0.00	1.62	0.82	1.86	4.39	0.62	1.25	1.97	0.07	
	2023	0.16	0.02	0.85	0.23	4.20	0.55	0.54	0.63	1.51	5.32	1.37	1.29	
Total Average Monthly Rainfall		**0.85**	**0.80**	**1.62**	**1.59**	**2.83**	**2.12**	**1.40**	**2.12**	**2.47**	**2.81**	**1.27**	**0.80**	**20.67**

Note: N/A represents no data was recorded.

Table 1-3. Kerr County Monthly Rainfall (1993-2023) (inches)

Station Name	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Average Annual Rainfall
Harper 3 Ene, TX - USC00413954	1993	1.59	1.32	1.66	2.65	1.98	1.85	0.00	0.00	2.33	1.96	0.45	1.24	
	1994	1.52	0.98	2.18	1.52	4.46	2.82	0.20	1.80	6.21	3.44	2.87	3.06	
	1995	0.44	0.72	2.97	2.74	7.05	2.66	1.09	0.88	6.71	0.65	1.34	0.54	
	1996	0.00	0.00	1.14	0.72	2.23	0.57	0.87	1.89	5.81	8.43	3.64	1.66	
	1997	1.35	8.91	4.70	5.94	2.68	10.05	0.84	1.41	0.69	2.61	1.06	2.68	
	1998	1.49	2.89	0.80	0.48	1.94	2.58	0.35	7.27	2.16	4.52	3.42	1.00	
	1999	0.05	0.00	5.49	1.82	5.03	4.04	2.63	0.00	0.28	2.20	0.02	0.81	
	2000	0.73	1.96	1.58	1.45	5.76	3.89	0.31	0.12	3.01	4.59	7.44	1.14	
	2001	2.34	1.58	2.93	0.85	2.65	0.96	1.07	3.57	2.54	2.10	8.62	1.43	
	2002	1.03	0.72	1.70	1.93	1.12	2.69	10.66	0.87	1.27	5.39	1.04	1.80	
	2003	0.51	1.64	1.65	0.07	1.53	5.19	2.17	3.74	4.59	4.78	0.81	0.08	
	2004	1.82	2.41	2.60	3.95	1.78	13.66	1.28	2.49	1.27	2.14	4.31	0.66	
	2005	1.98	3.24	4.22	n/a	n/a	n/a	n/a	n/a	0.00	1.52	0.75	0.00	
	2006	1.14	0.73	1.43	4.68	5.10	1.49	1.86	1.14	4.44	3.20	0.02	1.01	
	2007	2.94	0.06	6.24	2.23	11.43	5.99	5.12	6.08	4.12	0.47	0.82	0.15	
	2008	0.20	0.18	1.37	1.59	2.40	0.75	1.33	2.72	0.34	0.74	0.07	0.23	
	2009	0.32	0.13	3.68	3.25	1.41	0.42	1.40	1.78	5.86	4.69	2.07	1.25	
	2010	4.30	2.40	3.45	5.21	2.06	1.29	4.04	0.00	5.16	0.13	0.17	0.33	
	2011	0.98	0.61	0.00	0.31	0.96	0.20	0.30	0.12	0.81	0.80	1.24	3.60	
	2012	2.07	2.71	5.11	0.05	5.03	1.09	1.06	0.60	5.22	0.75	0.06	0.34	
	2013	3.86	1.01	0.82	1.24	5.44	1.38	1.94	0.55	7.90	3.59	1.72	0.74	
	2014	0.00	0.10	0.09	0.75	6.34	2.06	1.17	1.84	3.19	2.36	1.99	0.60	
	2015	2.88	0.11	3.67	1.68	7.59	2.75	0.77	1.20	0.18	5.52	4.66	1.10	
	2016	0.00	1.11	3.77	3.66	5.50	1.33	0.88	3.57	1.91	1.02	3.55	0.10	
	2017	1.34	3.56	1.28	1.55	2.18	3.91	1.94	3.25	2.79	0.22	0.65	2.21	
	2018	0.10	2.13	0.51	0.72	3.34	0.81	1.51	1.61	9.80	9.54	1.00	3.56	
	2019	0.98	0.24	1.34	3.27	7.28	2.30	0.57	3.22	0.36	1.83	1.50	0.26	
	2020	2.12	1.38	6.38	4.17	8.22	2.16	0.48	0.67	3.29	0.38	n/a	1.06	
	2021	2.10	1.86	0.80	1.11	4.87	2.78	2.71	2.78	0.65	4.57	1.40	0.60	
	2022	0.57	0.68	0.24	1.83	0.98	0.77	0.94	5.96	1.05	1.09	2.67	0.34	
	2023	0.51	0.39	1.03	2.50	4.41	1.93	0.08	0.19	2.63	n/a	n/a	4.35	
Total Average Monthly Rainfall		**1.33**	**1.48**	**2.41**	**2.06**	**3.96**	**2.72**	**1.60**	**1.98**	**3.12**	**2.75**	**1.91**	**1.22**	**26.54**

Note: N/A represents no data was recorded.

Table 1-4. Kinney County Monthly Rainfall (1993-2023) (inches)

Station Name	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Average Annual Rainfall
Brackettville, TX - USC00411007	1993	0.00	0.10	0.46	1.64	n/a	0.63	0.33	0.30	1.14	0.12	0.12	0.13	
	1994	n/a	0.43	2.18	4.06	3.35	0.50	2.94	0.24	6.00	2.26	0.63	0.52	
	1995	0.00	0.86	n/a	0.60	4.79	2.76	0.00	3.67	6.48	0.13	3.39	0.27	
	1996	0.00	0.78	0.24	0.50	3.55	0.00	1.62	3.10	3.52	6.11	1.92	0.90	
	1997	0.80	2.28	3.00	2.93	2.62	5.68	1.12	0.15	3.14	1.76	2.78	0.84	
	1998	0.59	0.41	1.53	0.00	0.00	3.00	0.00	11.56	2.15	3.28	1.31	0.33	
	1999	0.12	0.00	3.32	0.91	2.85	7.34	2.38	0.85	0.85	1.53	0.00	0.00	
	2000	0.10	1.10	0.98	0.60	n/a	n/a	0.09	0.25	3.67	8.59	4.11	0.41	
	2001	1.10	0.62	2.16	0.25	4.74	1.01	0.73	3.82	1.91	1.60	2.83	0.00	
	2002	0.00	0.00	1.35	1.46	0.58	2.15	4.80	0.00	1.53	n/a	n/a	n/a	
	2003	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
	2004	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
	2005	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
	2006	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.14	
	2007	2.09	0.03	5.16	0.52	6.56	6.35	17.22	0.56	2.50	1.95	0.90	0.83	
	2008	0.00	0.20	0.54	n/a	2.69	n/a	n/a	n/a	0.82	0.70	0.00	0.10	
	2009	0.40	0.00	2.67	0.95	1.50	0.70	n/a	n/a	n/a	n/a	n/a	n/a	
	2010	n/a	3.04	0.77	2.64	4.89	3.72	2.53	2.51	2.08	0.00	0.05	0.02	
	2011	0.13	0.16	0.02	0.68	0.74	0.11	1.25	0.17	0.73	0.72	0.03	1.28	
	2012	0.57	0.58	2.08	0.94	5.09	0.00	2.50	1.44	2.99	0.07	0.25	0.11	
	2013	1.18	0.01	0.20	0.41	3.26	10.05	0.30	0.61	5.56	2.55	0.92	0.41	
	2014	0.01	0.31	0.11	0.28	2.46	10.06	2.80	2.85	0.29	0.43	0.00	0.71	
	2015	1.50	0.45	3.21	4.15	8.28	1.70	0.30	1.60	0.19	4.54	0.28	0.00	
	2016	1.24	1.20	1.84	2.20	5.57	0.00	0.00	10.30	8.30	0.00	1.92	3.68	
	2017	0.95	3.93	0.75	3.00	3.44	1.79	0.00	0.50	2.00	0.00	0.00	1.79	
	2018	0.00	0.13	0.00	0.95	0.60	0.00	n/a	n/a	7.93	n/a	1.20	1.85	
	2019	n/a	n/a	0.18	2.13	n/a	n/a	n/a	n/a	0.63	n/a	n/a	n/a	
Brackettville 0.1 NE, TX - US1TXKY0003	2020	1.32	0.18	2.20	5.03	2.00	2.09	0.00	0.60	4.16	0.29	0.44	1.12	
	2021	0.98	1.04	0.42	2.19	1.19	1.74	1.85	1.86	0.99	2.45	0.29	0.26	
	2022	n/a	0.32	n/a	0.29	3.70	0.04	1.00	8.69	0.90	2.28	0.98	0.05	
	2023	0.23	n/a	1.38	0.25	3.29	0.35	0.45	1.59	0.74	0.46	0.31	n/a	
Total Average Monthly Rainfall		**0.43**	**0.59**	**1.19**	**1.28**	**2.51**	**1.99**	**1.43**	**1.85**	**2.30**	**1.35**	**0.80**	**0.54**	**16.23**

Note: N/A represents no data was recorded.

Table 1-5. Real County Monthly Rainfall (1993-2023) (inches)

Station Name	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Average Annual Rainfall
Prade Ranch, TX - USC00417232	1993	1.18	1.63	1.38	2.18	2.10	2.40	0.00	0.00	4.19	1.05	0.32	1.48	
	1994	2.14	1.20	5.22	1.67	5.92	5.23	1.96	1.14	1.74	2.41	2.60	3.17	
	1995	0.32	0.24	2.12	1.85	2.11	4.37	0.41	1.97	7.52	0.44	3.21	0.05	
	1996	0.00	0.06	0.85	1.61	4.68	1.05	0.99	3.58	5.97	8.98	2.97	0.82	
	1997	1.07	4.80	3.61	3.36	3.68	12.28	0.21	0.15	1.23	4.57	1.13	0.75	
	1998	3.08	1.80	2.92	0.00	1.60	2.37	0.00	14.17	2.28	2.39	3.84	0.58	
	1999	0.60	0.00	3.53	3.72	3.74	3.77	2.08	0.00	0.00	1.36	0.00	0.70	
	2000	0.20	1.62	0.42	0.73	4.00	5.20	0.18	0.52	1.93	12.17	8.30	0.30	
	2001	2.45	1.23	2.39	2.77	3.85	0.27	0.00	4.16	3.70	0.90	10.18	2.40	
	2002	0.00	0.97	1.08	2.98	3.56	1.39	6.26	0.32	2.35	7.95	0.90	2.57	
	2003	0.35	2.00	1.10	0.00	1.22	3.70	2.80	2.60	6.08	4.03	2.44	0.35	
	2004	1.49	0.62	4.16	8.36	1.05	12.66	0.30	1.74	2.86	2.48	7.25	1.15	
	2005	1.40	1.78	1.84	0.77	3.71	1.20	3.05	2.07	0.00	3.83	0.70	0.00	
	2006	0.53	0.60	0.65	1.35	1.75	2.72	2.53	0.73	6.96	4.03	0.00	0.78	
	2007	2.38	0.00	6.59	2.20	7.03	9.17	6.01	2.54	5.40	0.70	0.90	0.68	
	2008	0.19	0.00	0.73	0.55	1.33	0.00	1.69	1.27	2.09	0.75	0.00	0.25	
	2009	0.25	0.27	2.95	3.20	2.57	0.00	0.74	0.20	4.15	2.35	0.84	1.18	
	2010	3.34	4.20	1.81	4.15	3.04	0.47	3.89	1.14	3.24	0.00	0.00	1.36	
	2011	0.72	0.52	0.00	0.30	1.15	0.35	1.41	1.09	2.12	1.80	1.92	2.65	
	2012	1.12	3.46	1.40	1.33	6.86	0.15	1.95	0.97	4.47	0.10	0.40	0.00	
	2013	2.30	0.02	0.35	1.80	7.01	2.82	2.42	0.77	3.80	4.57	1.85	0.78	
	2014	0.00	1.20	0.10	0.00	5.70	4.09	1.66	2.80	3.25	0.72	2.74	0.55	
	2015	1.68	0.29	2.96	2.95	11.59	4.78	0.00	0.92	0.00	7.98	4.05	1.67	
	2016	1.27	1.10	2.82	1.90	7.86	3.25	0.48	5.95	7.68	0.05	1.05	2.25	
	2017	1.05	3.00	1.96	2.75	3.85	2.52	0.20	2.61	4.75	0.60	0.15	4.04	
	2018	0.50	1.52	0.67	1.45	1.74	0.00	2.80	4.60	10.25	14.44	0.45	3.60	
	2019	0.00	0.45	2.03	2.90	2.80	3.52	0.55	1.48	0.10	1.24	1.6	0.00	
	2020	2.80	1.90	4.59	3.15	3.64	0.81	1.68	3.59	3.83	0.40	n/a	1.60	
	2021	2.92	1.77	0.80	1.12	6.62	6.58	1.31	2.48	1.85	1.71	0.66	0.23	
	2022	0.25	0.37	0.09	1.02	1.83	0.20	1.19	5.00	1.42	1.69	2.74	0.17	
	2023	0.73	0.30	0.58	1.25	7.34	2.16	0.81	1.09	2.04	4.42	1.55	1.54	
Total Average Monthly Rainfall		**1.17**	**1.26**	**1.99**	**2.04**	**4.03**	**3.21**	**1.60**	**2.31**	**3.46**	**3.23**	**2.09**	**1.21**	**27.60**

Note: N/A represents no data was recorded.

Table 1-6. Val Verde County Monthly Rainfall (1993-2023) (inches)

Station Name	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Average Annual Rainfall
Del Rio International Airport, TX - USW00022010	1993	0.60	0.77	0.47	0.72	1.29	5.28	0.97	2.54	0.77	0.68	0.13	0.18	
	1994	2.36	1.61	2.49	1.74	2.61	0.05	5.07	0.57	1.24	1.70	0.39	3.14	
	1995	0.03	0.31	1.06	0.75	7.33	0.16	0.08	1.11	3.06	2.13	1.24	0.49	
	1996	0.00	0.39	0.02	0.62	1.20	0.02	0.07	4.77	2.09	0.88	0.87	0.34	
	1997	0.20	2.01	2.77	2.55	5.66	3.70	0.77	0.23	1.41	2.39	0.77	0.55	
	1998	0.01	0.34	1.06	0.01	0.08	1.35	0.00	20.93	1.43	1.46	1.94	0.24	
	1999	0.01	0.01	1.89	3.17	0.29	5.61	1.48	2.42	0.00	0.39	0.00	0.01	
	2000	0.03	0.94	0.28	0.90	1.03	4.38	0.65	0.11	1.32	5.00	2.82	0.51	
	2001	1.08	0.54	0.90	0.22	1.33	0.00	0.13	0.35	2.24	0.43	1.12	0.35	
	2002	0.01	0.02	0.10	1.44	1.81	3.09	0.87	0.63	1.28	7.39	0.73	0.31	
	2003	0.32	0.43	0.68	0.09	6.90	1.01	5.34	0.92	3.36	4.47	0.37	0.04	
	2004	0.81	0.74	3.48	3.34	2.39	2.28	1.79	2.48	3.96	4.57	4.71	0.40	
	2005	0.90	1.38	1.74	0.09	2.49	0.10	3.73	1.69	0.02	8.72	0.00	0.06	
	2006	0.25	0.04	0.16	0.59	1.83	2.07	0.01	1.36	2.38	0.53	0.01	0.36	
	2007	2.22	0.03	2.36	1.93	7.93	4.61	4.72	1.25	3.49	0.76	1.18	0.32	
	2008	0.08	0.02	0.57	0.06	0.58	2.73	0.97	11.32	0.28	0.16	0.00	0.41	
	2009	0.03	0.00	1.52	1.86	0.46	3.06	0.17	0.06	3.37	0.65	0.71	1.01	
	2010	2.52	1.54	1.16	6.03	10.45	0.71	4.72	0.57	2.06	0.01	0.01	0.00	
	2011	0.08	0.15	0.04	0.01	1.07	0.45	0.37	4.49	1.14	0.39	0.75	0.98	
	2012	0.48	1.20	1.31	1.20	4.49	0.01	1.00	0.11	3.90	0.06	0.05	0.04	
	2013	1.33	0.00	0.06	0.36	1.47	1.76	2.77	0.74	4.44	1.40	0.66	0.48	
	2014	0.00	0.22	0.32	0.08	0.73	4.69	0.35	0.78	4.23	1.24	3.26	0.25	
	2015	0.77	0.22	2.21	1.71	10.17	3.48	0.04	2.02	0.50	5.79	0.56	0.34	
	2016	0.68	0.07	2.08	4.16	1.62	2.93	0.05	10.26	5.92	0.11	2.11	2.48	
	2017	0.19	0.78	0.51	5.64	3.97	2.46	0.66	1.68	6.33	0.43	0.03	1.74	
	2018	0.00	0.19	0.13	0.01	1.23	0.59	2.15	4.11	7.75	8.73	0.06	1.26	
	2019	0.14	0.11	0.41	1.24	3.51	7.85	0.00	0.00	0.10	0.86	0.55	0.05	
	2020	0.67	0.28	3.09	1.41	1.21	0.44	0.45	0.50	3.17	0.17	0.02	1.26	
	2021	0.33	0.35	0.21	1.12	4.03	2.00	2.27	2.87	0.32	1.98	0.64	0.26	
	2022	0.02	0.14	0.00	0.64	1.93	0.24	0.00	7.57	2.45	2.38	0.62	0.00	
	2023	0.14	0.07	1.85	1.18	5.02	0.10	1.66	1.84	0.08	1.77	0.74	0.62	
Total Average Monthly Rainfall		**0.53**	**0.48**	**1.13**	**1.45**	**3.10**	**2.17**	**1.40**	**2.91**	**2.39**	**2.18**	**0.87**	**0.60**	**19.20**

Note: N/A represents no data was recorded.

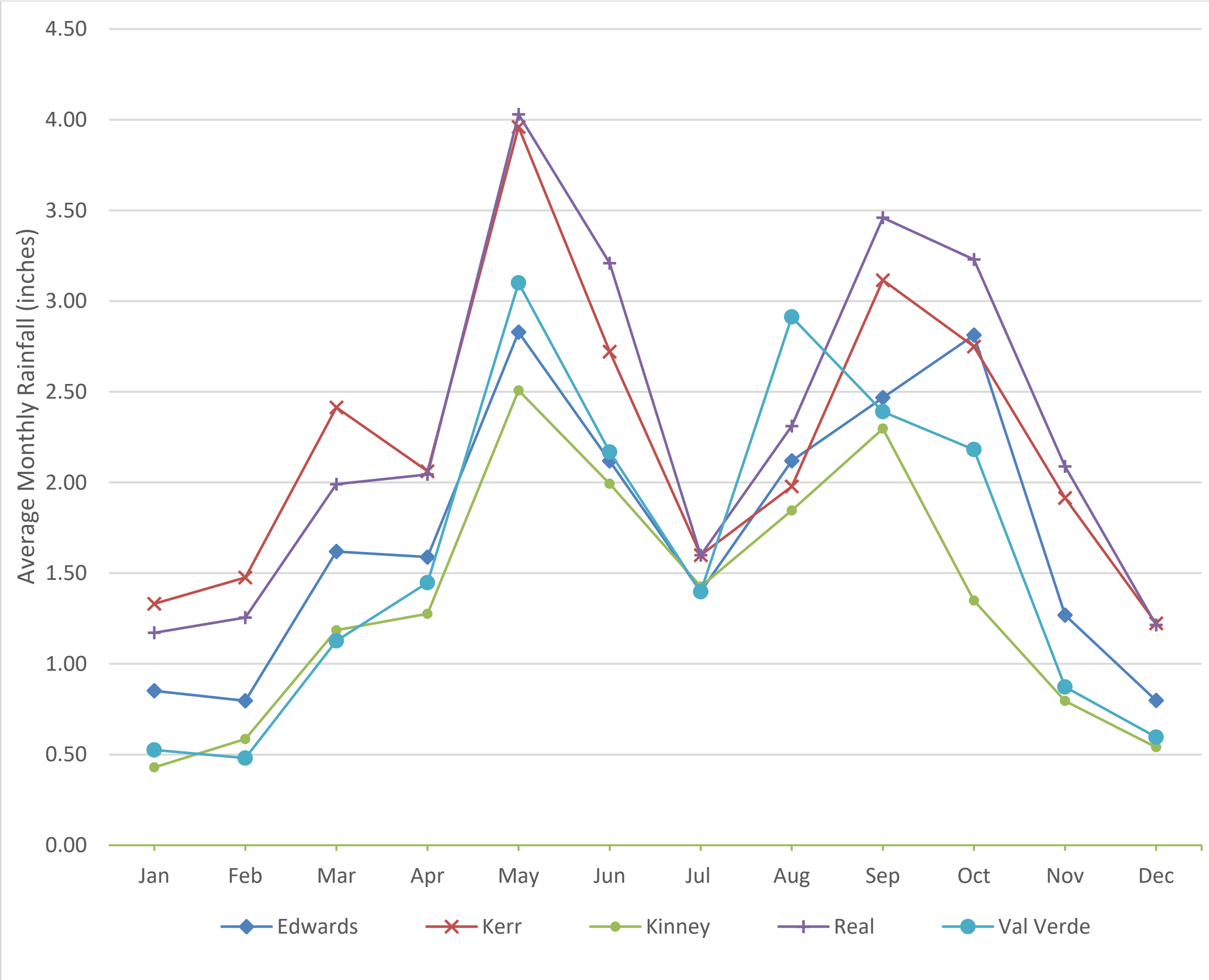

Figure 1-7. Average Monthly Rainfall for Selected Stations
Source: NCEI

Drought conditions are assumed in the planning process to ensure that adequate infrastructure and planning is in place under severe water shortage conditions. Drought in the Plateau Region is discussed in detail in Chapter 7 of this *Plan*. Drought in the Plateau Region can be defined in the following operational definitions:

Meteorologic drought is an interval of time, usually over a period of months or years, during which precipitation cumulatively falls short of the expected supply.

Agricultural drought is that condition when rainfall and soil moisture are insufficient to support the healthy growth of crops and to prevent extreme crop stress. It may also be defined as a deficiency in the amount of precipitation required to support livestock and other farming or ranching operations.

Hydrologic drought is a long-term condition of abnormally dry weather that ultimately leads to the depletion of surface water and groundwater supplies, the drying up of lakes and reservoirs, and the reduction or cessation of spring flow or streamflow.

Comparing the 1950s Drought of Record (DOR) and the current drought can be accomplished by using historic precipitation, stream flow records, spring discharges, and water level measurements in wells for locations that have accumulated data measurements since the 1940s, which is discussed further in Chapter 7 Section 7.2. For this planning cycle, the drought of the 1950s is declared the DOR. However, it is the intent of the current *2026 Plan*, to illustrate in Chapter 7 that although the 1950s drought is the Historic DOR, current drought conditions are of major significance. Current preparation for drought in the Plateau planning region is presented in detail in Chapter 7. Existing GCD and water utility drought management plans and actions are recognized, drought monitoring triggers and actions are recommended (Table 7-8), and emergency response options are discussed.

1.2.6 Native Vegetation and Ecology

A biotic province is a considerable and continuous geographic area that is characterized by the occurrence of one or more ecologic associations that differ, at least in proportional area covered, from the associations of adjacent provinces. In general, biotic provinces are characterized by peculiarities of vegetation type, ecological climax, flora, fauna, climate, physiography, and soil. Most of the Plateau Region has been classified as belonging to the "Balconian" Biotic Province, but small portions of Val Verde and Kinney Counties also lie within the "Tamaulipan" and "Chihuahuan" Biotic Provinces (Figure 1-8). In the 1800s, the area was predominantly savannas of tall native grasses with occasional stands of Live Oak and Spanish Oak. While Live Oak and Spanish Oak are still prevalent in many areas, most of the Region has become blanketed by Ashe Juniper (commonly referred to as "Mountain Cedar") largely because of the suppression of prairie fires in the last century. Another infestation of tree species found in the area is that of Mesquite. Infestation of trees may reduce the quantity and quality of water from watersheds, as well as reduce the diversity of plant species beneath the trees' canopies.

Cypress trees line the banks of many of the rivers and are known to reduce flows in the streams during their active season. Along with the Live Oak, Spanish Oak, and Cypress, other species of trees that are generally found are Post Oak, Elm, Hackberry, Cottonwood, Sycamore, and Willow. Native grass species include Little and Big Bluestem, Indian Grass, Sideoat Grama, and Texas Winter Grass. Some of the introduced species of grass include Coastal Bermuda, Plains Lovegrass, Klein Grass, and King Ranch Bluestem. In the western portion of the Region, a varying growth of prickly pear, other cactus species, sage, and other brushy species predominate.

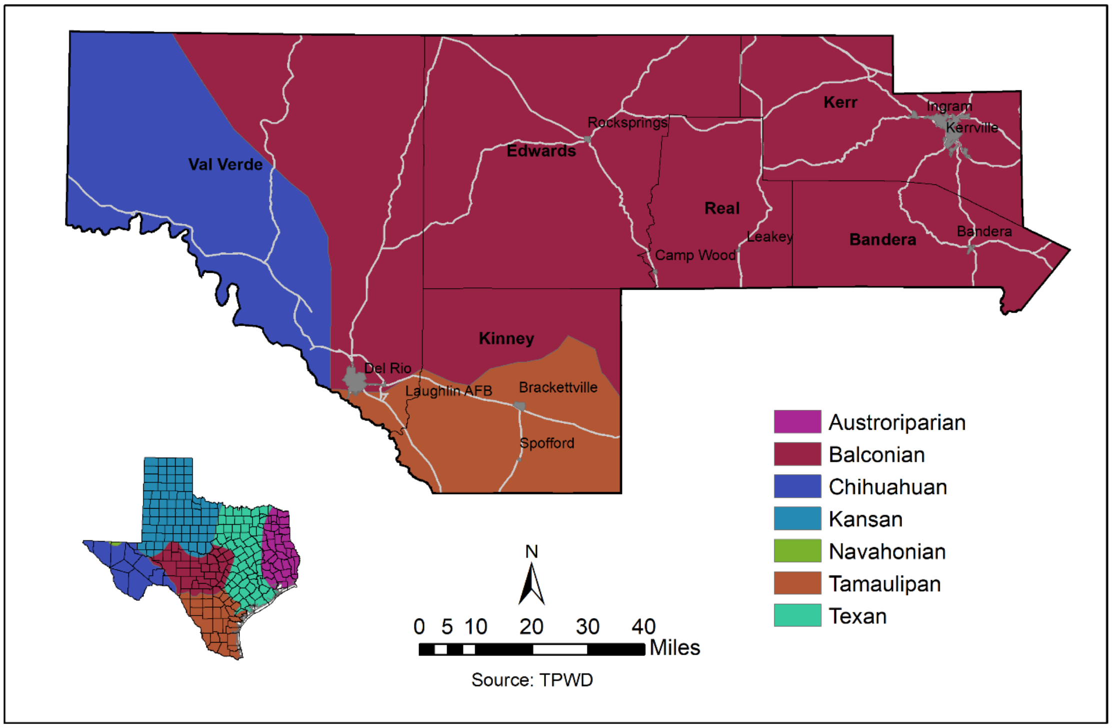

Figure 1-8. Biotic Provinces

1.2.7 Vegetative Management and Land Stewardship

The PWPG strongly believes that the concept of properly managing rural lands is essential in maintaining natural spring flows in the headwaters of surface streams and rivers. Several invasive species have been recognized in the Plateau Region, as well as elsewhere in the State, that have a negative impact on surface water flow in springs, creeks and rivers, as well as recharge to underlying aquifers. Species of major concern are Giant River Cane (Arundo donax) and Elephant Ears (Colocasia esculenta) in watersheds, and the encroachment of woody species such as Ashe Juniper and Mesquite.

Vegetative management of Ashe Juniper, also commonly known as "cedar" has become a significant source of discussion and debate as to its impact on water resources on the Edwards Plateau. Cedar is native to central Texas and was initially controlled through both man-made and natural fires and through foraging. As these events were reduced, cedar returned and has been expanding in the Region. Eradication methods have included controlled burns, use of heavy equipment to pull the plant up by its roots, mechanical cutting, and chemical methods. There has been a great deal of debate regarding the impact on water resources by cedar with various groups calculating how much water cedar takes away from both groundwater and surface water sources. In a 2003, report done by A.A. McCole of the University of Texas Geology Department, it was noted that "in late summer and winter the Ashe Juniper (cedar) obtains approximately between 72 percent and 100 percent of its water from groundwater. In contrast, during the wet periods of the year, spring and fall, mass balance calculations indicate that between 45 percent and 100 percent of Ashe Juniper's water is derived from soil water. This seasonal shift indicates the presence of Ashe Juniper can appreciably reduce groundwater resources both by lateral roots intercepting potential recharge during the wet season and direct uptake of groundwater by deep roots during the dry season. Ashe Juniper will directly compete with grasses for soil water during the wet season, limiting herbaceous productivity."

In 2010, the USGS published a study, "Effects of Brush Management on the Hydrologic Budget and Water Quality in and Adjacent to Honey Creek State Park Natural Area, Comal County, Texas 2001-2010." The results of this study indicated that brush eradication did not increase runoff to streams but did suggest that clearing brush can result in more infiltration. The study found that before clearing potential groundwater recharge was 17 percent of the total water budget but increased to 24 percent after clearing. The study showed that prior to clearing, a rainfall event produced a potential recharge of 5.91 inches of the rain that fell, and after clearing, it increased to 7.09 inches; for a difference of 1.18 inches. In terms of actual water, the extra 1.18 inches amounts to approximately 32,042 gallons per acre. Thus, to obtain one-acre foot of water, 10 acres will need to be cleared to gain an additional acre foot of water as infiltration. From these and other studies, brush eradication can have a positive impact on groundwater recharge and a limited impact on surface water runoff. However, with increased groundwater recharge it is reasonable to assume that a portion of this groundwater would percolate down to aquifers as well as provide base flow to surface water via springs.

Vegetative management of Giant River Cane (Arundo donax) has become a significant problem throughout the Plateau Region. The problems with the Arundo donax are a direct result of its incredible growth potential. Individual shoots can grow upwards of four inches per day and a mature stand can be approximately 30 feet tall. To support these high growth rates the plant requires significant amounts of water. When compared to native species, Arundo donax requires three times as much water at a minimum. The United States Department of Agriculture (USDA) scientists have calculated that each acre of Arundo donax requires approximately 4.37-acre feet of water to support proper growth. Thus, 1,000 acres of Arundo donax will consume approximately 4,370-acre feet of water per year.

The eradication methods identified to control the Arundo donax are mechanical, chemical, and biological. Additionally, any combination of these three treatment protocols can be an effective treatment option. Mechanical control involves removing all portions of the living plant. Due to the plant's high silicon count, the plant is very flammable and highly susceptible to burning. This approach is not recommended as the burning does not affect the root structure.

Chemical control has proven to be the most effective, which uses glyphosate. Glyphosate interferes with the plants' synthesis of nutrients. Biologic control seems to hold promise for eradication. The USDA has been experimenting with using the asexual Arundo Wasp and has received permits to use this wasp in the eradication efforts. Due to the Arundo donax being highly invasive, the Texas Legislature passed legislation making it illegal to sell or distribute Arundo donax without a permit from the Texas Department of Agriculture (TDA).

Vegetative management and land stewardship are potentially feasible water management strategies under regional water planning guidelines. However, in order to meet rule requirements, the recommended strategies would need to be able to document a firm yield under drought-of-record conditions. In previous plans, the TWDB has argued that during a drought-of-record, the additional runoff or recharge attained from vegetative management strategies are not sustained during a prolonged drought, and thus the supply benefit under these conditions will be zero. However, the PWPG strongly feels that drought mitigation measures such as vegetative management are an effective water conservation practice that can reduce water scarcity and improve soil moisture, which reduces the impact of drought.

1.2.8 Agricultural and Natural Resources

Agricultural resources in the Region include beef cattle, sheep, goat, and exotic game animals. Apple and pecan orchards, along with hay, are grown in the eastern part of the Region. Kinney County, with its extensive irrigated lands in the western half of the county, accounts for twice the amount of water used for irrigation as the rest of the Region combined.

The natural resources of the Region include both terrestrial and aquatic habitats that boast some of the best scenic drives and vistas, river rafting, and hunting and fishing in Texas. Natural resources also include the great diversity of plant and animal wildlife that inhabit these environments. TPWD maintains a comprehensive source of information on State and Federally listed rare, threatened, and endangered plants and animals, and Species of Greatest Conservation need (last updated January 31, 2024).

Understandably, both local residents and tourists make use of these resources in their enjoyment of numerous public parks, dude ranches, resorts, recreational vehicle parks, and camping facilities. The following protected sites located within the Plateau Region depend upon adequate water to supply both environmental and recreational needs:

- Lost Maples State Natural area.
- Hill Country State Natural Area.
- Devil’s River State Natural Area.
- Seminole Canyon State Historic Park.
- Dolan Falls Ranch Preserve (Nature Conservancy).
- Devils Sinkhole State Natural Area.
- Kickapoo Cavern State Park.
- Kerrville-Schreiner Park.
- Heart of the Hills Fisheries Science Center.
- Amistad National Recreation Area.
- Love Creek Preserve.
- Bandera Canyonlands.

Both agricultural and natural resources water-supply needs are directly influenced by the quantity and quality of water available primarily in rivers and tributaries that flow through the Region and to a lesser extent on impounded lakes, ponds, and tanks. Except for the Rio Grande, much of the drainage basins for the headwater of local rivers lie within Plateau Region counties. Spring flow emanating from bedrock aquifers, particularly the Edwards-Trinity (Plateau) Aquifer, create the base flow of these streams. As such, these headwater watershed areas are particularly susceptible to drought conditions as the water table naturally drops and spring flow diminishes.

Agricultural activities in the Region that rely on surface water are designed to accommodate the intermittent nature of the supply. In most cases, this means that agricultural water-supply needs will be supplemented by groundwater sources, or that irrigation activities will cease until river supplies are replenished. Both plant and animal species endemic to this Region have developed a tolerance for the intermittent nature of surface water availability; however, significantly long drought conditions can have a severe effect on these species. Riparian water needs for birding habitat is particularly critical.

Of recognized importance to the water planning process is the concern of the impact that future development of water supplies might have on preexisting conditions in the Region. Water-supply management strategies developed in Chapter 5 of this *Plan* include an evaluation of each strategy's impact on agricultural, natural resources, and environmental concerns (see Tables 5-2 and 5-4, and Appendix 5B).

The principal potential impact to agriculture is the possible change in water rights use from agricultural use to municipal use of Guadalupe River flows in Kerr County. As these strategies only potentially change the use of the water and not the volume of diversion, there is no anticipated significant impact to natural resources.

1.2.9 Upper Llano River Watershed Protection Plan

"The Upper Llano River, which includes the North and South Llano Rivers, is a true gem of the Texas Hill Country. Due to the pristine nature and relatively constant flow of its springs, the Upper Llano is currently a healthy ecosystem supporting a variety of aquatic and terrestrial communities and numerous recreational opportunities" (Upper Llano River Watershed Protection Plan Brochure). As part of the Healthy Watersheds Initiative under the Clean Water Act, the Upper Llano River Watershed Plan was published and implemented in 2016. The South Llano River Watershed contains portions of Edward, Kerr, and Real Counties, all within the Plateau Region planning area. Voluntary implementation efforts will focus on the following conservation measures:

- Repair and replace septic systems.
- Decrease the feral hog population by 66 percent.
- Increase the number of ranches with wildlife management plans by at least two annually, particularly in riparian areas.
- Enroll more than 250,000 acres of ranchlands in conservation plans.
- Treat more than 144,000 acres of brush to improve range conditions and increase water supply.
- Begin restoration on 14 miles of areas lacking a riparian buffer and begin to improve vegetation conditions along 10 percent of the riparian zone.
- Identify and implement best management practices to address urban runoff.
- Improve water use efficiency by 10 percent.

1.2.10 Water Supply Source Vulnerability / Security

Following the events of September 11th, 2001, Congress passed the Bio-Terrorism Preparedness and Response Act. Drinking water utilities serving more than 3,300 people were required to have completed vulnerability preparedness assessments and response plans for their water, wastewater, and stormwater facilities. The United States Environmental Protection Agency (EPA) funded the development of three voluntary guidance documents, which provide practical advice on improving security in new and existing facilities of all sizes. The documents include:

- Interim Voluntary Security Guidance for Water Utilities.
- Interim Voluntary Security Guidance for Wastewater / Stormwater Utilities.
- Interim Voluntary Guidelines for Designing an Online Contaminant Monitoring System.

1.2.11 Supply Source Protection

According to the 1996 Safe Drinking Water Act Amendments, the TCEQ is required to assess every public drinking water source for susceptibility to certain chemical constituents. The Source Water Protection Program (SWPP) is a voluntary program designed to help public water systems identify and implement measures that will protect their sources of water from potential contamination. Assessment reports are provided to the public water systems and are often used to implement local source water protection projects. Table 1-7 lists Plateau Region public water systems involved in the TCEQ's SWPP 2014-2023).

Table 1-7. Plateau Region Source Water Protection Participants

PWS Name	County	Report Date
Latigo Ranch Subdivision	Bandera	2023
City of Bandera	Bandera	2020
City of Rocksprings	Edwards	2016
Center Point Taylor System	Kerr	2014

1.3 REGIONAL WATER DEMAND

1.3.1 Major Demand Categories

Total estimated year 2030 water consumptive use in the Plateau Region is 50,980 acre-feet (ac-ft). The largest category of demand is municipal and county-other (32,738 ac-ft), followed by irrigation (15,238 ac-ft), livestock (2,655 ac-ft), mining (312 ac-ft), and manufacturing (37 ac-ft). Municipal, county-other, and irrigation combined represent 94 percent of all water use in the Region (Figure 1-9). Current and projected water demand for all water-use types is discussed in detail in Chapter 2.

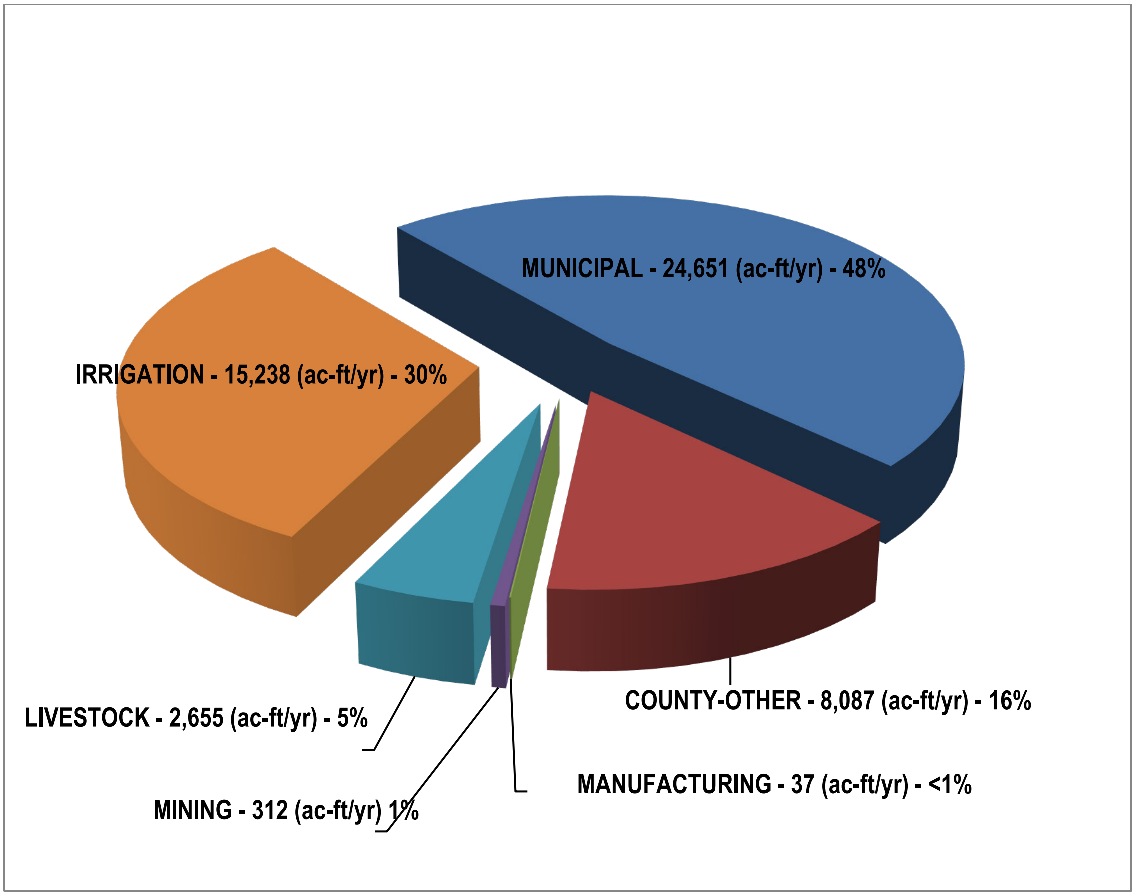

Figure 1-9. Year 2030 Projected Water Demand by Water-Use Category

1.3.2 Municipal

Municipal demand consists of both residential and commercial water uses. Commercial water consumption includes business establishments, public offices, and institutions, but does not include industrial water use. Residential and commercial uses are categorized together because they are similar types of uses, i.e., they both use water primarily for drinking, cleaning, sanitation, air conditioning, and landscape watering.

The largest center of municipal demand is served by Del Rio Utilities in Val Verde County, where 12,977 ac-ft of water is estimated to be used in 2030 to supply residents and businesses. Forty one percent of regional municipal water is used in Val Verde County, and 29 percent is used in Kerr County.

Del Rio Utilities is the only entity in the Plateau Region that is designated as a Major Water Provider (MWP). In addition to its own use, the City provides water to Laughlin Air Force Base and subdivisions outside of the City. The City also provides water and wastewater services to two colonias, Cienegas Terrace and Val Verde Park Estates.

1.3.3 Agriculture and Ranching

Agriculture and ranching water demand consist of all water used by the agricultural industry to support the cultivation of crops and the watering of livestock and wildlife. Where groundwater is the source of irrigation water, the TWDB defines irrigation use as "on farm demand." Where surface water is the source of irrigation water, the TWDB defines irrigation use as both "on farm" demand and "diversion loss." Surface water is typically conveyed by an open canal system, which exposes the water supply to possible loss from seepage, breaks, evaporation, and uptake by riparian vegetation. In the year 2030, irrigation is projected to represent the second greatest water use in the Region (15,238 ac-ft) with Kinney County accounting for 44 percent of the regional total. Livestock use in the Region amounted to 2,655 ac-ft.

1.3.4 Manufacturing and Mining

Manufacturing (and industrial) demand consists of all water used in the production of goods for domestic and foreign markets. Some processes require direct consumption of water as part of the manufacturing process. Others require very little water consumption but may require large volumes of water for cooling or cleaning purposes. In some manner or another, water is passed through the manufacturing facility and used either as a component of the product or as a transporter of waste heat and materials. Within the Plateau Region, manufacturing is accounted for in Kerr, Real, and Val Verde Counties.

Mining demand consists of all water used in the production and processing of nonfuel (e.g., sulfur, clay, gypsum, lime, salt, stone, and aggregate) and fuel (e.g., oil, gas, and coal) natural resources by the mining industry. In all instances, water is required in the mining of minerals either for processing, leaching to extract certain ores, controlling dust at the plant site, or for reclamation. This also includes the production of crude petroleum and natural gas. Water used in the mining industry in the Plateau Region is principally reported in Bandera, Edwards, Kerr, and Val Verde Counties.

1.3.5 Environmental and Recreational Water Needs

Environmental and recreational water use in the Plateau Region is recognized as being an important consideration as it relates to the natural community in which the residents of this Region share and appreciate. In addition, for rural counties, tourism activities based on natural resources offer perhaps the best hope for modest economic growth to areas that have seen a long decline in traditional economic activities such as agriculture.

A goal of this *Plan* is to provide for the health, safety, and welfare of the human community, with as little detrimental effect to the environment as possible. To accomplish this goal, the evaluation of strategies to meet future water needs (Chapter 5) includes a distinct consideration of the impact that each implemented strategy might have on the environment.

Recreation activities involving human interaction with the outdoor environment are often directly dependent on water resources. It is recognized that the maintenance of the regional environmental community's water-supply needs serves to enhance the lives of citizens of the Plateau Region as well as the tens of thousands of annual visitors to this Region. Environmental and recreational water needs are further discussed throughout the *Plan* and especially in Chapters 2, 3, and 8.

1.4 WATER SUPPLY SOURCES

Water-supply sources in the Plateau Region include groundwater primarily from six aquifers and surface water from five river basins. Reuse of existing supplies is also considered a water-supply source. A more detailed description of these sources and estimates of their supply availability are provided in Chapter 3.

1.4.1 Groundwater

Within the Plateau Region, the TWDB recognizes three major aquifers: The Trinity, the Edwards-Trinity (Plateau), and the Edwards (Balcones Fault Zone [BFZ]). For this *Plan,* the Austin Chalk Aquifer in Kinney County, the Frio and Nueces River Alluvium Aquifers in Real and Edwards Counties, and the Ellenburger-San Saba Aquifer in Kerr County have also been identified as groundwater sources (Figure 1-10). GCDs in Bandera, Kerr, Kinney, Real, and Edwards Counties provide for local management control of their groundwater resources.

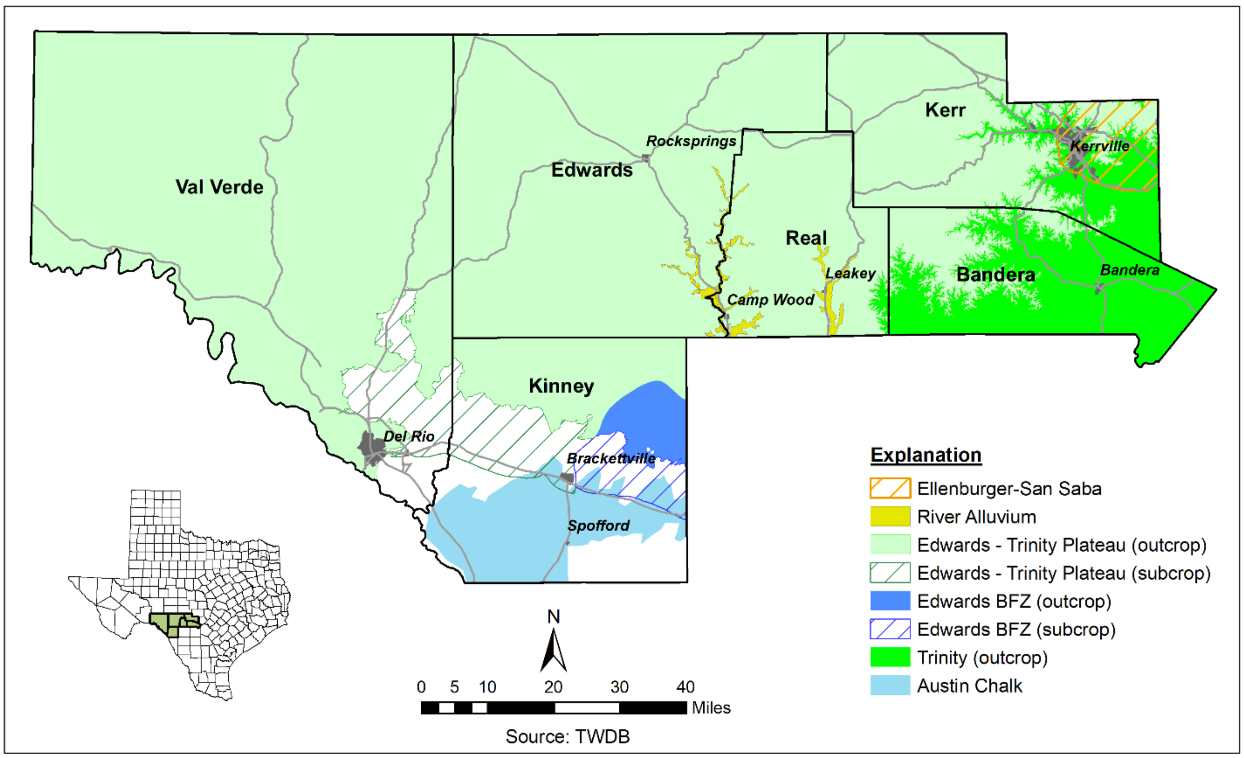

Figure 1-10. Groundwater Sources

1.4.1.1 Trinity Aquifer

The Trinity Aquifer occurs in its entirety in a band from the Red River in North Texas to the Hill Country of south-central Texas and provides water in all or parts of 55 counties. Trinity Group formations also occur as far west as the Panhandle and Trans-Pecos regions where they are included as part of the Edwards-Trinity (High Plains) and Edwards-Trinity (Plateau) Aquifers.

The Trinity Aquifer in south-central Texas has been further subdivided into:

- Upper Trinity Aquifer:
    - Upper Glen Rose Limestone.
- Middle Trinity Aquifer:
    - Lower Glen Rose Limestone.
    - Hensell Sand / Bexar Shale.
    - Cow Creek Limestone.
- Lower Trinity Aquifer:
    - Sligo Limestone / Hosston Formation.

1.4.1.2 Edwards-Trinity (Plateau) Aquifer

Rock formations of the Edwards-Trinity (Plateau) Aquifer form the Edwards Plateau east of the Pecos River, and in its entirety, provide water to all or parts of 38 counties. The Aquifer extends from the Hill Country of Central Texas to the Trans-Pecos region of West Texas. The Aquifer consists of saturated sediments of lower Cretaceous age Trinity Group formations and overlying limestones and dolomites of the Edwards Group. The Glen Rose limestone is the primary unit in the Trinity in the southern part of the Plateau. Springs issuing from the Aquifer form the headwaters of several eastward and southerly flowing rivers. Some of the largest springs of the area are in Val Verde and Kinney Counties, such as San Felipe Springs near Del Rio and Los Moras Springs in Brackettville.

1.4.1.3 Edwards (BFZ) Aquifer

The Edwards (BFZ) Aquifer in its entirety covers approximately 4,350 mi² in parts of 11 counties. It forms a narrow belt extending from a groundwater divide in Kinney County through the San Antonio area northeastward to the Leon River in Bell County. Within the Plateau Region, water in the Aquifer generally moves from the recharge zone toward natural spring discharge points such as Las Moras Springs near Brackettville or southeasterly underground toward San Antonio.

1.4.1.4 Austin Chalk Aquifer

The Austin Chalk Aquifer occurs in the southern half of Kinney County and in the southernmost extent of Val Verde County. Most Austin Chalk wells discharge only enough water for domestic or livestock use; however, primarily in the area along Las Moras Creek, a few wells are large enough to support irrigation.

1.4.1.5 Nueces River Alluvium Aquifer

The Nueces River Alluvium occurs along the boundary between Edwards and Real Counties. Extending over an area of approximately 24,450 acres, the alluvial aquifer contains approximately 3,574 ac-ft of annually available water. The Community of Barksdale, local subdivisions, and other rural domestic homes derive their water supply from this Aquifer.

1.4.1.6 Frio River Alluvium Aquifer

The Frio River Alluvium in central Real County extends over an area of approximately 9,530 acres and contains approximately 2,145 ac-ft of annually available water. Water supplies for the Community of Leakey, several subdivisions, and other rural domestic homes are derived from this small Aquifer.

1.4.1.7 Ellenburger-San Saba Aquifer

The Ellenburger-San Saba Aquifer was added to the previous plan as a new source. During this cycle of regional water planning, there was a test hole exploration, pumping test results, and water chemistry analysis, which verified that this Aquifer does provide a potential source of water that can meet the supply needs of northeastern Kerr County. In 2023, the City of Kerrville assumed ownership of the new Ellenburger production well, which produced approximately 89 ac-ft. The Headwaters GCD has authorized rules for future permitting of this resource.

1.4.1.8 Other Aquifers

Located along many of the streams and rivers throughout most of the Region are shallow alluvial floodplain deposits mostly composed of gravels and sands eroded from surrounding limestone hills. Wells completed in these deposits supply small to moderate quantities of water mostly for domestic and livestock purposes.

1.4.2 Surface Water

The Plateau Region is unique within all planning regions in that it straddles five river basins rather than generally following a single river basin or a large part of a single river basin (Figure 1-11). From west to east, included within the Region are the Rio Grande, Nueces, Colorado, Guadalupe, and San Antonio River Basins. The headwaters of rivers that form the Nueces, Guadalupe, and San Antonio River Basins originate within this Region, and the headwaters of the South Llano River, a major tributary to the Colorado River, also occur here.

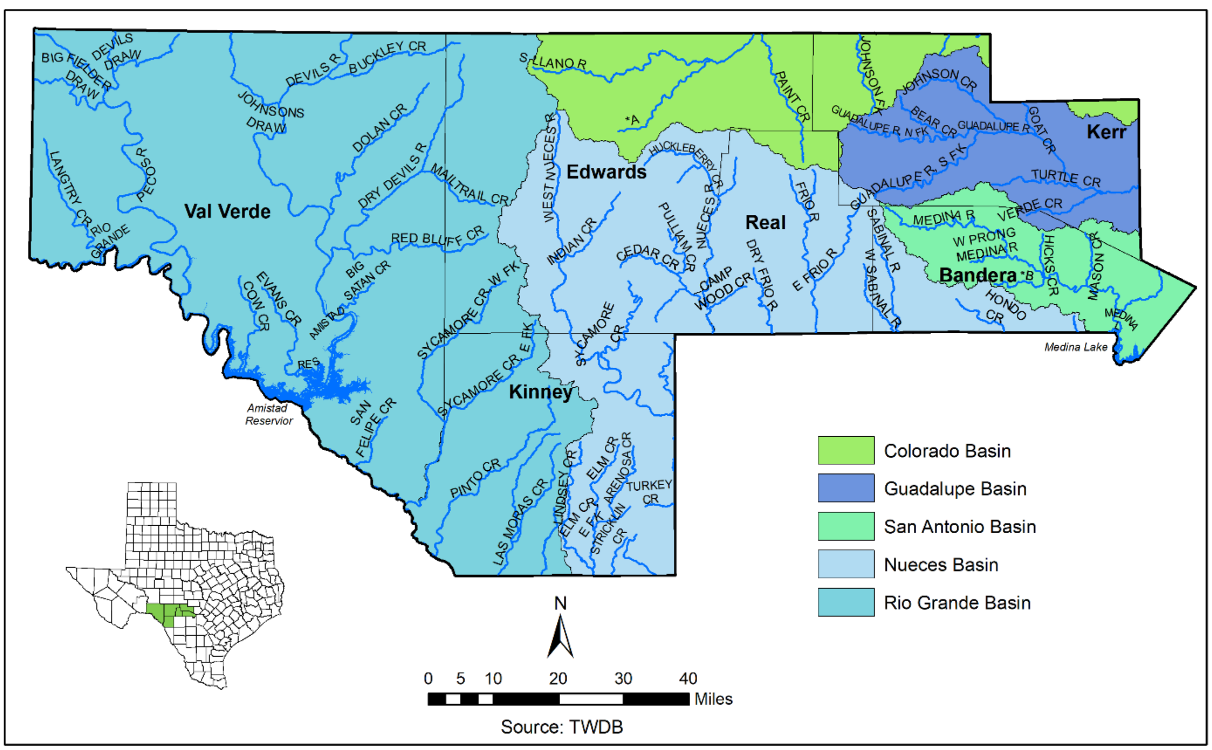

Figure 1-11. Surface Water Sources

1.4.2.1 Rio Grande Basin

The Rio Grande, or Rio Bravo as it is known in Mexico, forms the border between the United States and Mexico. International treaties governing the ownership and distribution of water in the Rio Grande are discussed in Chapter 3. The 3.4 million-ac-ft International Amistad Reservoir is located on the Rio Grande in Val Verde County. Within the Plateau Region, the Pecos and Devil's Rivers in Val Verde County are the primary tributaries to the Rio Grande. Numerous springs, including San Felipe, Goodenough, and Las Moras, issue from the Edwards Aquifer and flow into tributaries of the Rio Grande. The mainstream of the Rio Grande does not provide water for municipal use in the Plateau Region and only provides limited amounts for irrigation use, primarily from a tributary, San Felipe Creek.

1.4.2.2 Nueces River Basin

The main stem of the Nueces River forms a portion of the border between Edwards and Real Counties. Tributaries of the Nueces River located in the Plateau Region include the Sabinal River and Hondo Creek in Bandera County, the West Nueces River in Edwards and Kinney Counties, and the Frio, East Frio, Dry Frio Rivers in Real County, and other minor tributaries.

1.4.2.3 Colorado River Basin

The City of Rocksprings in Edwards County straddles the drainage divide between the Nueces River Basin and the Colorado River Basin. The portion of Edwards County north of Rocksprings, small northern portions of Real County, and the northwestern part of Kerr County drain to the Llano River watershed in the Colorado River Basin. The South Llano River, part of the headwaters of the Llano / Colorado, begins in Edwards County.

1.4.2.4 Guadalupe River Basin

Most of Kerr County lies in the Guadalupe River Basin. The Guadalupe River is not only an important water-supply source for Kerrville and other communities in Kerr County but is also a major tourist attraction for the area. Although Kerrville and the UGRA own water rights, much of the flow of the Guadalupe is permitted for downstream use.

1.4.2.5 San Antonio River Basin

Bandera County is mostly split between the Nueces and San Antonio River Basins. The Medina River flows through Bandera County and drains to the San Antonio River. Medina Lake straddles the boundary between Bandera, Medina, and Bexar Counties and serves as a major irrigation source for land downstream in Medina County. This reservoir has a conservation storage capacity of 254,823 ac-ft. In the spring of 2015, the reservoir was only 3.5 percent full; however, as of March 2019 the reservoir had recovered to full capacity. Since 2019, the reservoir has not reached 100 percent full conservation storage capacity, and as of July 2024 it remains at 3.6 percent full. The firm yield of Medina Lake and its associated Diversion Lake is zero.

1.4.3 Springs and Wildlife Habitat

Springs have played an important role in the development of the Plateau Region. They were important sources of water for Native American Indians, as indicated by the artifacts and petroglyphs found in the vicinity of many of the springs. These springs were also principal sources of water for early settlers and ranchers. Although springs are often recognized by a given name, in reality most springs are complexes of numerous openings through which groundwater flows to the surface. Additional discussion pertaining to springs and their function in the relationship between groundwater and surface water is contained in Chapter 3.

The PWPG has identified three "Major Springs" that are important for their municipal water supply (Figure 1-12). The fourth largest spring in Texas, San Felipe Springs, discharges to San Felipe Creek east of Del Rio and provides municipal drinking water for Del Rio, as well as irrigation use downstream. Las Moras Springs in Kinney County is of historical significance for its importance as a supply source on early travel routes and military fortifications. Today, Las Moras Springs supports the Fort Clark community and is hydrologically associated with the same aquifer system that serves Fort Clark Municipal Utility District and the City of Brackettville. The third major spring is Old Faithful in Real County, which is the drinking water-supply source for the City of Camp Wood. While still the major contributor to the City of Camp Wood's water supply, it is no longer the sole source, as the City has drilled a deep well (Trinity aquifer) that supplements the spring especially during drought conditions.

Although only three springs are identified as "Major Springs," the PWPG recognizes that all springs in the Region are important and are deserving of natural resource protection. The PWPG also recognizes the important ecological water-supply function that all springs perform in the Region. Springs create and maintain base flow to rivers, contribute to the esthetic and recreational value of land, and are significant sources of water for wild game and aquatic species. Water issuing from springs forms wetlands that attract migratory birds and other fowl throughout the year. The wetlands host numerous terrestrial and aquatic species, some of which are listed as threatened or endangered.

Two supplemental study reports were prepared in 2005 for the PWPG that address springs (Table 1-1). The first report considers the location and geohydrology of springs in Kinney and Val Verde Counties, and the second report relates spring flow in western Kerr County to base flow in the three branches of the upper Guadalupe River.

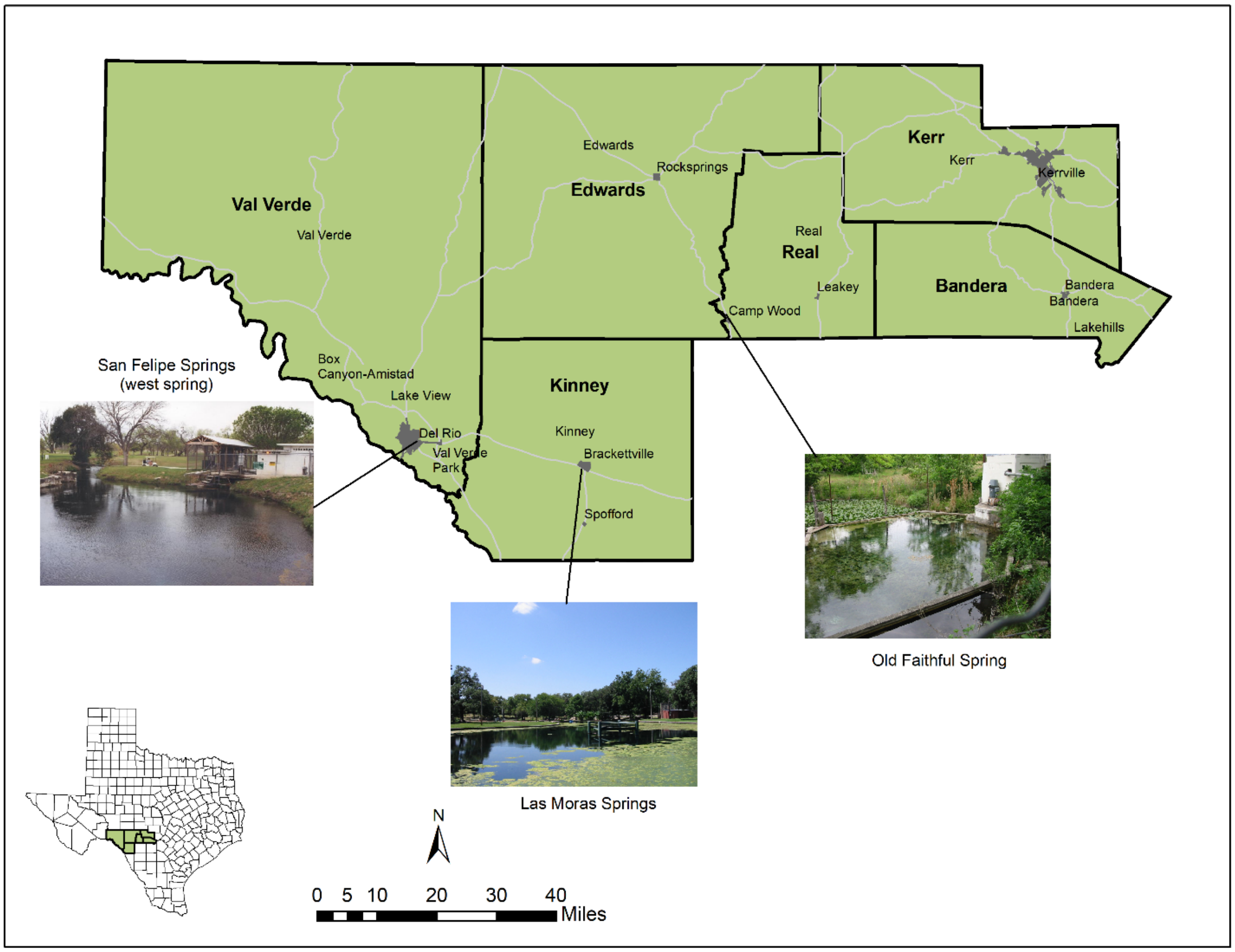

Figure 1-12. Major Springs

1.4.4 Reuse

Water recycling, or reuse, is reusing treated wastewater for beneficial purposes such as agricultural and landscape irrigation or industrial processes. The Cities of Kerrville and Bandera have active water reuse programs. Del Rio Utilities in Val Verde County is planning on making reuse a future supply, all of which is described in Chapter 3.

1.4.5 Water Quality Issues

Water quality is generally good throughout the Plateau Region; however, a few specific water quality issues should be mentioned. Increasing population impacts water quality in many ways, one of which is the increase in urban runoff that comes with the increase in impervious cover in populated areas. Impervious cover concentrates runoff into storm sewers and drains, which then discharges into streams, increasing the flow, which also increases the erosional power of the water. In addition, urbanization also causes increased pollutant loads, including sediment, oil / grease / toxic chemicals from motor vehicles, pesticides / herbicides / fertilizers from gardens and lawns, viruses / bacteria / nutrients from human and animal wastes including septic systems, and heavy metals from a variety of sources.

Increasing population has also manifested itself in the fragmentation of larger properties. With the advent of fragmentation comes the proliferation of new wells being drilled to serve the individual properties. Each new well thus becomes another potential conduit for surface contamination to reach the underlying aquifer system.

From a regional perspective, groundwater quality is relatively good. However, the constituent of most concern is nitrate, which is found above the primary maximum contaminant level in a number of water sample analyses from the Edwards (BFZ) Aquifer and the Austin Chalk Aquifer in Kinney County.

Historically, the primary contribution to poor groundwater quality occurs in wells that do not have adequately cemented casing. Improperly completed wells allow poorer quality water to migrate into zones containing good quality water. Poorer groundwater quality in the Region is generally from two different sources, evaporite beds in the Glen Rose formation and from surface contamination, both of which can be prevented by proper well construction. Also, of concern are above normal levels of radioactivity that have been detected in sand sequences of the Glen Rose and Hensell formations in some areas.

1.5 COLONIAS

Disadvantaged political subdivisions, often referred to as "colonias," represent a special subset of municipal demand in the Region, and a challenge to water suppliers. Most colonias are subdivisions in unincorporated areas located along the United States / Mexico international border and typically consist of small land parcels sold to citizens of low-income. These subdivisions often lack basic services such as potable water, sewage disposal and treatment, paved roads, and proper drainage. Public health problems are often associated with these colonias.

The Economically Distressed Area Program (EDAP) was created by the Texas Legislature in 1989 and is administered by the TWDB. The intent of the program is to provide local governments with financial assistance for bringing water and wastewater services to disadvantaged political subdivisions, including cities, counties, water districts, and non-profit water-supply corporations. An economically distressed area is defined as one in which water supply or wastewater systems are not adequate to meet minimal State standards, financial resources are inadequate to provide services to meet those needs, and there was an established residential subdivision on or prior to June 1, 2005. Affected counties are counties adjacent to the Texas / Mexico border, or that have per capita income 25 percent below the State median and unemployment rates 25 percent above the State average for the most recent three consecutive years for which statistics are available. Additional information pertaining to eligibility and requirements for the EDAP is available on the TWDB's website.

In 2019, the 86th Texas Legislature made changes to the program with the passage of Senate Bill 2452, which directed the TWDB to develop a system for prioritizing EDAP projects and consider projects that will have a "substantial effect." This includes projects serving areas determined to have a nuisance dangerous to public health and safety resulting from water supply and sanitation problems and projects for applicants subject to an enforcement action related to water supply or sewer service violations. EDAP projects in the Plateau Region are located in Kerr, Kinney, Real, and Val Verde Counties (Table 1-8). There are a total of three active projects and six completed projects within the Region.

Data pertaining to all EDAP projects in the State can be found within the SFY 2023 EDAP Annual Report, which can be accessed through the TWDB website.

Table 1-8. Economically Distressed Area Program Projects (August 31, 2023)

County	Sponsor	Project	EDAP Funding ($)	Other TWDB Funding ($)	Status
Kerr	Kerr County	Center Point Wastewater System	27,668,118.00	33,697,673.00	Active
	Upper Guadalupe RA	Center Point Water System	39,554.50		Completed
Kinney	Spofford	Brackettville Transmission Line	243,113.00		Completed
Real	Nueces River Authority	Leakey Wastewater System	20,251,979.20	9,961,460.00	Active
Val Verde	Val Verde County	Colonia Water Service	942,000.00		Active
	Val Verde County	Lakeview Estates Water & Wastewater	410,966.59		Completed
	Val Verde County	Water & Wastewater Planning	283,284.00		Completed
	Del Rio	Cienegas Terrace	3,245,986.00		Completed
	Del Rio	Val Verde Parke Estates	10,747,009.00		Completed

1.6 WATER LOSS AUDITS

Water is a precious and finite resource. Water loss control benefits utilities by conserving their water and diminishing their need for future acquisitions of additional water supply. Reducing water loss offers utilities the ability to increase their water-use efficiency, improve their financial status, and assist with long-term water sustainability.

In 2003, the 78th Texas Legislature, Regular Session, enacted House Bill 3338 to help conserve the State's water resources by reducing water loss occurring in the systems of drinking water utilities. This statute requires that all retail public utilities with more than 3,300 connections or a financial obligation to TWDB are required to submit a standardized water audit annually. All other retail public water suppliers are required to submit a water loss audit to TWDB every five years. The next five-year required submittal is due by May 1, 2026, for the 2025 audit year. However, it is strongly encouraged that all retail public water suppliers complete an audit annually to better track water loss and identify issues that need immediate addressing.

In response to the mandates of House Bill 3338, TWDB developed a water audit methodology for utilities that measures efficiency, encourages water accountability, quantifies water losses, and standardizes water loss reporting across the State. This standardized approach to auditing water loss provides utilities with a reliable means to analyze their water loss performance. Utilizing a methodology derived from the American Water Works Association (AWWA) and the International Water Association (IWA), the TWDB has published a manual that outlines the process of completing a water loss audit: "Water Loss Audit Manual for Texas Utilities" – TWDB Report 367 (2008).

Additionally, for the sixth cycle of regional water planning, the TWDB developed several helpful resource guides regarding water loss performance targets and water loss threshold values. These documents can be accessed on the TWDB's website page titled Conservation Resources for 2026 Regional Water Plan Development.

Historically, the AWWA recommended that entities with more than 10 percent water loss take corrective action. However, water loss industry standards have changed from recommending a one-size-fits-all target for water loss, to recommending water loss key performance indicators of apparent loss per connection per day, real loss per connection per day, and / or real loss per mile per day. Uses and limitations of key performance indicators have been developed by the AWWA's Water Loss Control Committee in their AWWA Water Loss Control Committee Report (2020).

The TWDB is required to evaluate the water loss of retail public utilities that request financial assistance for a water-supply project using water loss thresholds as an indicator of whether a utility must include funds for mitigating water loss as part of their request for financial assistance. RWPGs must consider strategies to address any issues identified in the water loss audit information. In order to determine a water loss threshold, TWDB established benchmarking values detailed in the Conservation Resource Guide for Development of the 2026 Regional Water Plans, which uses six years of water loss audit data and finds the median for two distinct groups of utilities for real loss, which is defined as the physical leakage of water from the distribution system. The two distinct groups of utilities identified are as follows: (1) retail public utilities located in less dense communities (less than 32 connections per mile), for which the threshold or median is 57 gallons per connection per day, and (2) retail public utilities locating in more dense communities (32 or more connections per mile), for which the threshold or median is 30 gallons per connection per day. These water loss thresholds are not a target but are only used for determining whether a utility may need to mitigate their water loss.

Table 1-9 provides a listing of reported utility audits performed in the Plateau Region that meet the key performance indicators discussed above. More details regarding reported annual water loss audit data can be accessed on the TWDB's website page titled Conservation Resources for 2026 Regional Water Plan Development.

Table 1-9. Plateau Region 2018-2022 Public Water System Real Water Loss Report for Utilities that Exceed Water Loss Performance Targets (gallons per year)

Public Water Supply (PWS) Name	Report Year	Service Connection on Density	Water Loss per Connection per Day	Corrected Input Volume	Reported Breaks Leaks	Unreported Loss	Total Real Losses	Cost of Real Losses ($)
Bridlegate Subdivision	2021	64.89	31.86	17,072,000	0	2,328,218	2,328,218	2,398
City of Bandera	2018	34.13	38.07	77,059,133	20,000	11,581,368	11,601,368	8,121
City of Kerrville	2018	61.32	46.07	1,455,155,670	175,953,360	28,481,337	204,434,697	516,811
	2019	58.52	35.69	1,218,044,330	1,994,705	147,943,583	149,938,288	61,475
	2020	39.13	68.54	1,274,814,433	2,635,793	241,042,576	243,678,369	102,345
	2022	51.23	31.00	1,346,347,475	84	135,707,279	135,707,363	56,997
City of Rocksprings	2020	50.67	56.76	71,958,333	50,000	11,117,019	11,167,019	33,501
	2021	61.90	51.12	62,110,309	80,000	10,187,759	10,267,759	30,803
Community Water Group WSC	2020	39.00	68.53	8,506,263	0	1,864,770	1,864,770	12,475
Del Rio Utilities Commission	2018	55.53	121.76	2,729,740,000	1,879,625	450,969,107	452,848,732	188,385
	2019	55.53	82.00	2,492,620,000	1,463,145	234,340,837	235,803,982	99,038
	2022	59.34	128.99	2,949,502,105	2,458,942	758,745,572	761,204,514	1,903,011
Flying L Ranch PUD	2019	34.00	48.52	19,946,842	227,442	3,569,625	3,797,067	835
Real WSC	2020	33.04	42.20	7,783,000	102,970	1,936,135	2,039,105	4,343
	2022	28.21	60.54	8,503,527	22,000	1,888,335	1,910,335	1,152
San Pedro Canyon Subdivision - Upper	2021	23.08	196.79	13,810,408	0	3,549,071	3,549,071	8,873
Tierra Del Lago	2018	22.11	226.58	3,855,300	0	1,497,027	1,497,027	599
	2019	22.11	247.55	4,018,100	0	1,657,385	1,657,385	663
	2021	22.11	355.12	4,796,000	125,000	2,356,817	2,481,817	993
	2022	23.16	368.63	5,020,800	122,200	2,719,394	2,841,594	1,137

1.7 STATE AND FEDERAL AGENCIES

1.7.1 TWDB

The TWDB, is the State agency charged with Statewide water planning and administration of low-cost financial programs for the planning, design, and construction of water supply, wastewater treatment, flood control, and agricultural water conservation projects. The TWDB, especially the Water Supply Planning Division is at the center of the legislatively mandated regional water planning effort. The agency has been given the responsibility of directing the process in order to ensure consistency and to guarantee that all regions of the State submit plans in a timely manner.

1.7.2 TCEQ

The TCEQ strives to protect the State's natural resources, consistent with a policy of sustainable economic development. TCEQ's goal is clean air, clean water, and the safe management of waste, with an emphasis on pollution prevention. The TCEQ is the major State agency with regulatory authority over State waters in Texas and administers water rights of the Lower Rio Grande through the office of the Watermaster. The TCEQ is also responsible for ensuring that all public drinking water systems are in compliance with the strict requirements of the State of Texas. TCEQ is involved with the TWDB in developing a State consensus water plan. Prior to permit approval, TCEQ is required to determine if projects are consistent with regional water plans.

1.7.3 TPWD

The TPWD provides outdoor recreational opportunities by managing and protecting wildlife and wildlife habitat and acquiring and managing parklands and historic areas. The agency currently has six internal divisions: Wildlife, Coastal Fisheries, Inland Fisheries, Law Enforcement, State Parks, and Infrastructure. TPWD is involved with the TWDB in developing a State consensus water plan. Specifically, the agency looks to see that statewide environmental water needs are included. A TPWD staff person is a non-voting member of the Plateau Water Planning Group and provides essential environmental expertise to the planning process.

1.7.4 TDA

The TDA was established by the Texas Legislature in 1907. The TDA has marketing and regulatory responsibilities and administers more than 50 separate laws. The current duties of the Department include: (1) promoting agricultural products locally, national, and internationally (2) assisting in the development of the agribusiness in Texas; (3) regulating the sale, use, and disposal of pesticides and herbicides; (4) controlling destructive plant pests and diseases; and (5) ensuring the accuracy of all weighing or measuring devices used in commercial transactions. The Department also collects and reports statistics on all activities related to the agricultural industry in Texas. A TDA staff person is a non-voting member of the Plateau Water Planning Group and provides essential agricultural expertise to the planning process.

1.7.5 TSSWCB

The TSSWCB is charged with the overall responsibility for administering and coordinating the State's soil and water conservation program with the State's soil and water conservation districts. The agency is responsible for planning, implementing, and managing programs and practices for abating agricultural and forest nonpoint source pollution. Currently, the agricultural / forest nonpoint source management program includes problem assessment, management program development and implementation, monitoring, education, and coordination.

1.7.6 South Texas Watermaster Program

The South Texas Watermaster Program is responsible for an area that encompasses 50 counties in south central Texas and manages water rights based on "run of the river rights." Individuals and groups are informed as needed concerning water rights and other matters related to availability of surface water. The water master program also updates and maintains water-right ownerships and assessments due to each water right account.

1.7.7 Public Utility Commission of Texas

The Public Utility Commission of Texas regulates the State's electric, telecommunication, and water and sewer utilities, implements respective legislation, and offers customer assistance in resolving consumer complaints.

1.7.8 International Boundary and Water Commission and Comisión Internacional de Límites y Aquas

The International Boundary and Water Commission (IBWC) and Comisión Internacional de Límites y Aquas (CILA) provide binational solutions to issues that arise during the application of United States_Mexico treaties regarding boundary demarcation, national ownership of waters, sanitation, water quality, and flood control in the border region; the treaties are discussed in Chapter 3.

1.7.9 United States Geological Survey

The United States Geological Survey (USGS) serves the Nation by providing reliable scientific information to (1) describe and understand the Earth, (2) minimize loss of life and property from natural disasters, (3) manage water, biological, energy, and mineral resources, and (4) enhance and protect quality of life. The USGS's Water Resources Division has played a major role in the understanding of the groundwater resources of Texas. Scientists with the USGS have conducted regional studies of water availability and water quality. Many of these studies have been conducted in conjunction with the TWDB. These studies have provided much of the data for more recent investigations conducted by graduate students and faculty members of many Texas universities.

1.7.10 United States EPA

The mission of the EPA is to protect human health and the environment. Programs of the EPA are designed (1) to promote national efforts to reduce environmental risk, based on the best available scientific information, (2) ensure that Federal laws protecting human health and the environment are enforced fairly and effectively, (3) guarantee that all parts of society have access to accurate information sufficient to manage human health and environmental risks, and (4) guarantee that environmental protection contributes to making communities and ecosystems diverse, sustainable, and economically productive.

1.7.11 United States Fish and Wildlife Department

The United States Fish and Wildlife Department (USFWS) enforces Federal wildlife laws, manages migratory bird populations, restores nationally significant fisheries, conserves and restores vital wildlife habitat, protects and recovers endangered species, and helps other governments with conservation efforts. It also administers a Federal aid program that distributes money for fish and wildlife restoration, hunter education, and related projects across the country. The USFWS has provided comments that are pertinent to wildlife water needs to draft planning documents.

1.7.12 UGRA

The UGRA was created as a conservation and reclamation district by the Texas Legislature in 1939. UGRA is a highly respected steward in managing the watershed and water resources of the Upper Guadalupe River benefiting both people and the environment. The mission of the UGRA is to conserve and reclaim surface water through the preservation and distribution of the water resources for future growth in order to maintain and enhance the quality of life for all Kerr County citizens.

1.7.13 Nueces River Authority

The Nueces River Authority (NRA) was created in 1935 by special act of the 44th Texas Legislature. Under supervision of the TCEQ, NRA has broad authority to preserve, protect, and develop surface water resources including flood control, irrigation, navigation, water supply, wastewater treatment, and water quality control. NRA may develop parks and recreational facilities, acquire and dispose of solid wastes, and issue bonds and receive grants and loans.

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CHAPTER 2
POPULATION AND WATER DEMAND

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2 POPULATION AND WATER DEMAND

Planning for the wise use of the existing water resources in the Plateau Region requires a reasonable estimation of current and future water needs for all water-use categories. Regional population and water demand data was initially provided to the PWPG at the beginning of the planning period, which incorporated data from the Texas Demographic Center (TDC) and the U.S. Census Bureau's 2020 census count. The PWPG requested revisions to specific population and municipal water demand categories for use in the *2026 Plateau Region Water Plan*, which were subsequently approved by the TWDB. Thus, the population and water demand projections shown in this Chapter are derived from a combination of TWDB data and the approved revisions.

The PWPG made available the draft population and water demand summary tables to municipalities, water providers, county judges, and non-municipal water-use representatives, and solicited all entities within the Region to submit desired changes to the projections along with supporting technical information justifying these changes. After thoughtful consideration, the PWPG chose to accept the draft population and water demand estimates and to include the TWDB approved revision requests provided by the water utilities. However, the PWPG did express reservations with the way that these population numbers are derived and strongly feel that the data provided by the TWDB does not represent the growth that many of the individual communities are experiencing. Requested revisions in the draft population and municipal water demand projections are outlined in more detail in Section 2.1.1 and Section 2.1.2 below.

Population projections and associated water demand projections have been assembled by utility service areas rather than political boundaries in order to better plan for the actual water-supply service entity. Earlier regional and State water plans had been aligned with political boundaries, such as city limits, rather than water utility service areas. TWDB rule changes now define a municipal WUG as being utility-based, and thus emphasis of the development of population and municipal water demands for the 2026 Regional Water Plans focus upon the utility-service area boundaries.

2.1 POPULATION

2.1.1 Population Projection Methodology

County population projections are prepared by the TDC and are based on the TDC's 2022 county-level projected demographic trends, including birth and survival rates and net migration rates of population groups defined by age, gender, and race / ethnicity.

Since the 2020 U.S. Census data was released after the publication of the *2021 Plateau Region Water Plan*, regional and county population totals were altered in the projections by the TWDB. Key changes from the previous planning cycle's projection methodology are as follows: (1) individual WUGs were adjusted to be representative of retail water service area boundaries rather than political city limit boundaries, as was done in the 2021 Plans, (2) the TWDB population projections for the regional and State water plans have always relied initially on county-level population projections from the TDC. In the past, the TWDB had altered the resulting regional plan population projections in certain counties by holding them constant in future periods to avoid projecting declining populations (and thus allowing for a potential underestimation of projected population for such counties). For the 2026 Regional Water Plans, the draft county population projections followed the trends projected by the TDC, including declines, and (3) future savings from additional faucet and dishwasher replacements were not considered necessary for inclusion in the draft plumbing code savings projections for this current planning cycle. Based on the effective year of the relevant plumbing code standards and the useful life of these items, the expected water efficiency savings by replacement and new growth would reasonably be fully realized by the first projected decade of 2030.

Population projections represent permanent residents, and not seasonal or transient populations. The population projection methodology was performed in two steps: (1) projections at the county level, and (2) then projections at the WUG level. County-level population projections were generally developed by examining three migration scenarios:

- Zero migration: no net migration (natural growth only).
- 1.0 migration: net migration rates of 2010 to 2020 ("full-migration scenario").
- 0.5 migration: 2010 to 2020 migration rates halved ("half-migration scenario").

The TWDB staff used the full-migration scenario to extend the TDC's projections to 2080 and to develop WUG-level projections. Although the TDC strongly recommends use of the half-migration scenario for long-term planning, the TWDB drafted populations for all planning regions using one consistent scenario. The half-migration scenario was also provided by the TWDB to the RWPGs for consideration.

The PWPG determined it was most appropriate to utilize the full-migration scenario for both Bandera and Kerr Counties. All other counties within the Region were approved using the half-migration scenario for the basis of developing the population projections. Additionally, a national undercount in population was applied demographically to the Region per WUG. The Hispanic population was under-represented by five percent, and the Black population was under-represented by 3.3 percent. Lastly, the PWPG identified within the Region that individual communities are growing at significantly different rates than was projected in the 2021 Regional Water Plan. To account for this growth, all WUGs were surveyed, soliciting more recent information on growth, water use, and / or future demands.

In the case of Laughlin Air Force Base, the PWPG submitted a population of 4,010, which was reported by the WUG, in the year 2020 and 2021 Annual Water Use Survey (WUS) and proposed holding constant throughout the planning horizon. The TWDB did not approve this request due to the quarter population for Laughlin Air Force Base being 1,574. The TWDB indicated that adequate justification was not provided to support the higher population. With the addition of the undercount analysis, the total population for Laughlin Air Force Base was approved for 1,640 and is held constant throughout the planning horizon.

The projected municipal population is allocated to water systems or utilities that provide an average of more than 100 ac-ft/yr for municipal use. This newly defined municipal WUG includes water systems that vary from privately-owned, systems serving institutions, facilities owned by the State and Federal government, and all other retail public utilities that meet the 100 ac-ft criteria.

Rural "county-other" population is calculated as the difference between the total projected population of the utility service areas and the total projected county population. Population is then projected from the 2020 base year by decade to the year 2080. However, individual WUGs were adjusted to reflect a utility-based boundary (not political boundary) as a baseline population to be projected for the use of this *Plan*. A more detailed explanation of the TWDB Population and Municipal Water Demand Projections for the 2026 Regional and 2027 State Water Plan can be found on the TWDB's website.

The PWPG expresses concern that the population projections do not recognize the impact to the municipal and rural population and its related water demand that occurs as the result of seasonal vacationers, hunters, and absentee land-owner homes, especially in the rural counties. The PWPG recommends that for future regional water plans, that a region be allowed to adjust the total regional population rather than having to adjust individual county populations to achieve a non-changeable total population.

2.1.2 Current and Projected Population

In the year 2020, the U.S. Census Bureau performed a census count, which provides the base year for future population projections. Although the PWPG approved the 2020 census count, to include the requested revisions, members again expressed concern that the census does not recognize the significant seasonal population increase that occurs as the Region draws large numbers of hunters and recreational visitors, as well as absentee landowners who maintain vacation, retirement, and hunting properties. Therefore, an emphasis is being made in this planning document, especially for the rural counties, to recognize a need for more water than is justified simply from the population-derived water demand quantities.

The cohort-component model used to project population growth does not adequately account for expected business and market factors that can influence population growth. Several Kerr County organizations are actively pursuing market development and business growth in order to maintain a consistent double-digit growth rate not reflected in the long-term population forecast. Similar underestimations may also occur elsewhere in the Region.

Population projections by decade for water utilities and county rural areas in the Plateau Region are listed in Table 2-1. The projected year-2030 population for the entire Region is 140,468, of which 80 percent reside in Kerr and Val Verde Counties (Figure 2-1). Del Rio, with a year-2030 projected population of 35,932, is the largest community in the Region.

The Regional population is projected to increase by approximately 10 percent to 154,530 by the year 2080, which is an increase of 14,062 citizens (Figure 2-2). The water demand table (Table 2-2) depicts water demand for county-other use as equally distributed throughout the rural portion of each county, whereas in reality, county-other population and water demand are often concentrated in smaller areas of the county, such as unincorporated communities, subdivisions and mobile home parks.

Population estimates do not consider rural population density, which concentrates water demand and strains available local water supplies. Figure 2-3 shows the concentration of rural population in the eastern portions of both Kerr and Bandera Counties. The challenge of meeting the water needs for these concentrated rural areas is addressed in water management strategies provided in Chapter 5.

Table 2-1. Plateau Region Population Projections

	2030	2040	2050	2060	2070	2080
Bandera County - Guadalupe Basin						
County-Other	111	113	115	118	120	123
Guadalupe Basin Total Population	**111**	**113**	**115**	**118**	**120**	**123**
Bandera County - Nueces Basin						
County-Other	1,041	1,062	1,083	1,105	1,127	1,150
Nueces Basin Total Population	**1,041**	**1,062**	**1,083**	**1,105**	**1,127**	**1,150**
Bandera County - San Antonio Basin						
Bandera	1,949	1,988	2,028	2,069	2,111	2,152
Bandera County FWSD #1	1,074	1,095	1,117	1,140	1,163	1,186
County-Other	17,340	17,690	18,046	18,411	18,778	19,150
San Antonio Basin Total Population	**20,363**	**20,773**	**21,191**	**21,620**	**22,052**	**22,488**
Bandera County Total Population	**21,515**	**21,948**	**22,390**	**22,843**	**23,300**	**23,760**
Edwards County - Colorado Basin						
Rocksprings	416	333	267	227	187	147
County-Other	127	102	81	69	57	45
Colorado Basin Total Population	**543**	**435**	**348**	**296**	**244**	**192**
Edwards County - Nueces Basin						
Rocksprings	250	200	160	137	113	88
County-Other	313	250	201	171	141	111
Nueces Basin Total Population	**563**	**450**	**361**	**308**	**254**	**199**
Edwards County - Rio Grande Basin						
County-Other	61	49	39	33	27	21
Rio Grande Basin Total Population	**61**	**49**	**39**	**33**	**27**	**21**
Edwards County Total Population	**1,167**	**934**	**748**	**637**	**525**	**412**
Kerr County - Colorado Basin						
County-Other	590	617	636	667	698	727
Colorado Basin Total Population	**590**	**617**	**636**	**667**	**698**	**727**

Table 2-1. (continued) Plateau Region Population Projections

	2030	2040	2050	2060	2070	2080
Kerr County - Guadalupe Basin						
Kerrville	33,035	34,549	35,614	37,318	39,037	40,680
Kerrville South Water	3,600	3,764	3,880	4,066	4,253	4,432
County-Other	19,667	20,566	21,201	22,216	23,237	24,217
Guadalupe Basin Total Population	**56,305**	**58,879**	**60,695**	**63,600**	**66,527**	**69,329**
Kerr County - Nueces Basin						
County-Other	8	9	9	9	10	10
Nueces Basin Total Population	**8**	**9**	**9**	**9**	**10**	**10**
Kerr County - San Antonio Basin						
County-Other	236	247	254	266	279	290
San Antonio Basin Total Population	**236**	**247**	**254**	**266**	**279**	**290**
Kerr County Total Population	**57,139**	**59,752**	**61,594**	**64,542**	**67,514**	**70,356**
Kinney County - Nueces Basin						
County-Other	21	20	19	19	19	18
Nueces Basin Total Population	**21**	**20**	**19**	**19**	**19**	**18**
Kinney County - Rio Grande Basin						
Brackettville	1,077	1,020	983	960	937	914
Fort Clark Springs MUD	1,372	1,299	1,252	1,223	1,194	1,164
County-Other	481	455	439	428	418	408
Rio Grande Basin Total Population	**2,930**	**2,774**	**2,674**	**2,611**	**2,549**	**2,486**
Kinney County Total Population	**2,951**	**2,794**	**2,693**	**2,630**	**2,568**	**2,504**
Real County - Colorado Basin						
County-Other	31	26	22	19	16	14
Colorado Basin Total Population	**31**	**26**	**22**	**19**	**16**	**14**
Real County - Nueces Basin						
Camp Wood	339	288	246	214	181	149
Leakey	210	179	153	133	113	92
County-Other	1,905	1,621	1,383	1,203	1,020	836
Nueces Basin Total Population	**2,454**	**2,088**	**1,782**	**1,550**	**1,314**	**1,077**
Real County Total Population	**2,485**	**2,114**	**1,804**	**1,569**	**1,330**	**1,091**
Val Verde County - Rio Grande Basin						
Del Rio Utilities Commission	35,932	36,018	36,105	36,191	36,278	36,365
Laughlin AFB	1,640	1,640	1,640	1,640	1,640	1,640
County-Other	17,639	17,915	18,144	18,229	18,315	18,402
Rio Grande Basin Total Population	**55,211**	**55,573**	**55,889**	**56,060**	**56,233**	**56,407**
Val Verde County Total Population	**55,211**	**55,573**	**55,889**	**56,060**	**56,233**	**56,407**
Region J Total Population	**140,468**	**143,115**	**145,118**	**148,281**	**151,470**	**154,530**

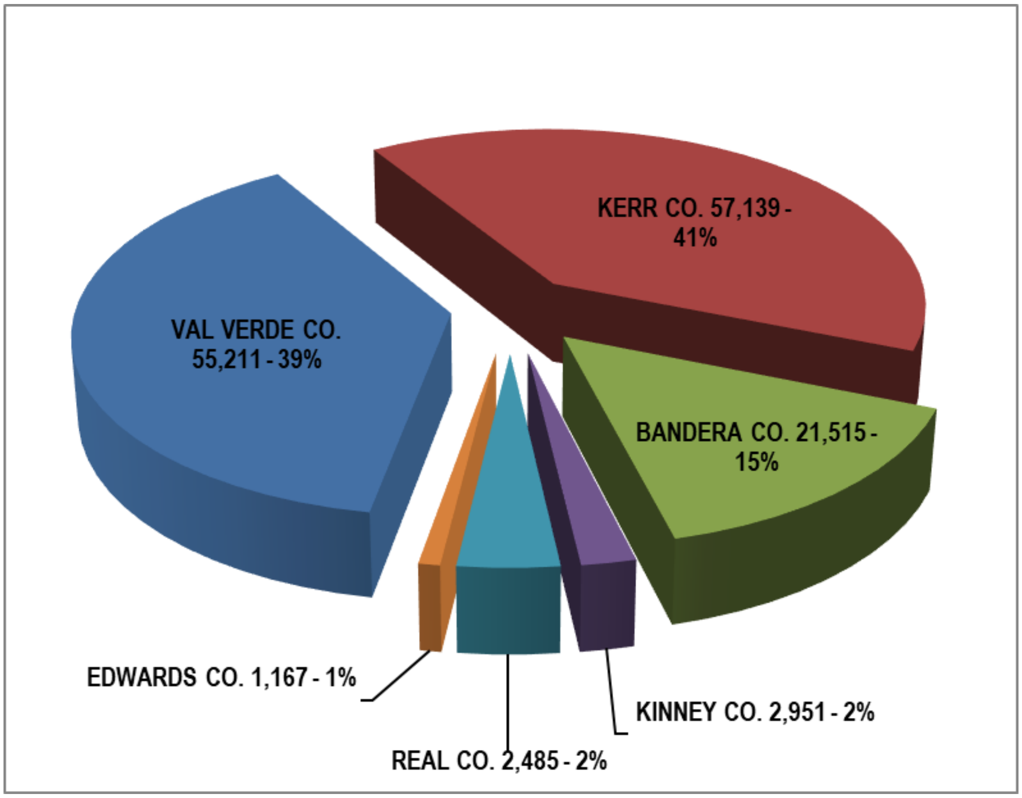

Figure 2-1. Year 2030 Population Projection

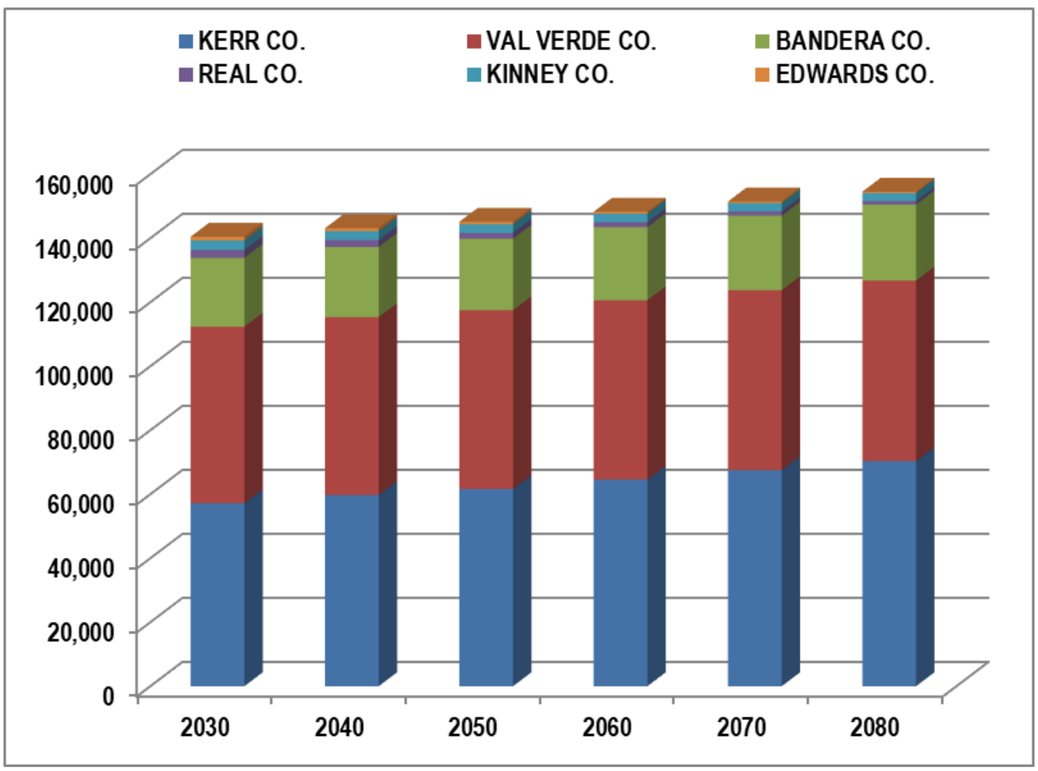

Figure 2-2. Regional Population Projection

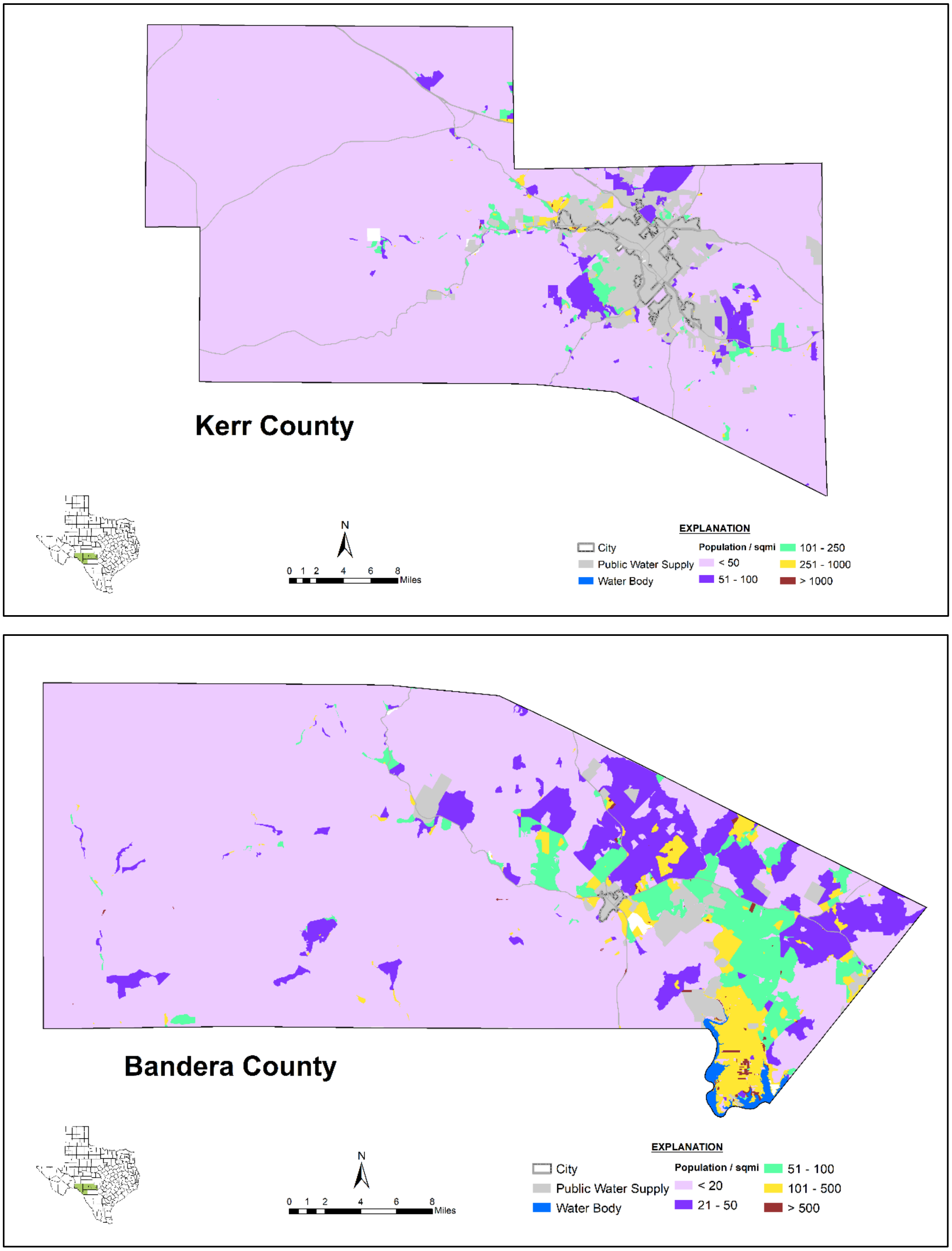

Figure 2-3. Rural Population Concentration in Kerr and Bandera Counties

2.2 WATER DEMAND

2.2.1 Water Demand Projections

A major component of water planning is the establishment of accurate water demand estimates for all water-use categories. Categories of water use include (1) municipal, (2) county-other (rural domestic), (3) manufacturing, (4) irrigation, (5) livestock, and (6) mining. There is no recognized water use in the Plateau Region for "steam-electric power generation." Other water-use categories that are not quantified in this *Plan* include environmental and recreational needs and are addressed in Section 2.3.

Municipal water demand projections are a function of population projections, baseline per capita use measured in units of gallons per capita per day (GPCD), and projected plumbing code savings. The following four steps are used in developing municipal water demand projections for WUGs: (1) develop population projections, (2) determine the baseline GPCD by WUG, (3) develop plumbing code savings projections by WUG, and (4) calculate municipal water demand projections.

In 2020 the TWDB was granted funding by the USGS to contract with the University of Texas Bureau of Economic Geology (UTBEG) to conduct a review of the projection methodology previously used for the mining category. The TWDB determined that the projections need to better reflect reported historical water use. The mining industry in Texas is critical to the State's and the Nation's economy, and the availability of adequate water is essential to many mining sectors. Accurate water-use estimates, and long-range projections associated with this industry are critical to the Texas water planning process. For more information, please read Water Use by Mining Industry in Texas Report.

Regardless of methodologies, the Planning Group anticipates that water demand is likely underestimated and, therefore, an emphasis is being made in this planning document to recognize a need for more water than is justified simply from the population-derived water demand quantities.

Table 2-2 lists the current and future projected regional water demand by county and water-use category. Figure 2-4 shows projected water demand by county in ac-ft/yr. Water demand is reported in "ac-ft"; one acre-foot is equivalent to a quantity of water one-foot-deep occupying one acre, or 325, 851 gallons.

Figure 2-5 presents the distribution of water demand in the Region by the six water-use categories. From the 2030 decade to the 2080 decade the total water demand in the Region is projected to increase from 50,980 ac-ft to 53,522 ac-ft.

The potential role of conservation is an important factor in projecting future water-supply requirements. In this *Plan,* conservation is included in the municipal projections as a measure of expected savings based on requirements of the State plumbing code. All other conservation practices are discussed in terms of water-supply management strategies in Chapter 5 and as a component of drought management plans in Chapter 7.

As stated previously, the PWPG is concerned that the population and subsequent water demand projections throughout the Region may be understated due to the large number of temporary residents in the Region including hunters, tourists and absentee landowners. In addition to these factors, water demand may be understated in Kerr County (as well as elsewhere in the Region) because the cohort-component model does not reflect market and business factors that are expected to increase water demand in the County, especially in the municipal and manufacturing use category.

Population estimates do not consider population density, which concentrates water demand and strains available local water supplies.

The following sections present an overview of water-supply demands for major water providers (MWPs) and for each of the six-designated water-use categories and include methods and assumptions used in the State's consensus water planning process.

Table 2-2. Plateau Region Water Demand Projections (Ac-ft/yr)

	2030	2040	2050	2060	2070	2080
Bandera County - Guadalupe Basin						
County-Other	12	12	13	13	13	13
Livestock	1	1	1	1	1	1
Guadalupe Basin Total Water Demand	**13**	**13**	**14**	**14**	**14**	**14**
Bandera County - Nueces Basin						
County-Other	113	115	117	120	122	124
Mining	1	1	1	1	1	1
Livestock	64	64	64	64	64	64
Irrigation	325	325	325	325	325	325
Nueces Basin Total Water Demand	**503**	**505**	**507**	**510**	**512**	**514**
Bandera County - San Antonio Basin						
Bandera	347	353	360	367	374	382
Bandera County FWSD #1	342	348	355	363	370	377
County-Other	1,888	1,916	1,954	1,993	2,033	2,074
Mining	1	1	2	2	2	2
Livestock	232	232	232	232	232	232
Irrigation	1,301	1,301	1,301	1,301	1,301	1,301
San Antonio Basin Total Water Demand	**4,111**	**4,151**	**4,204**	**4,258**	**4,312**	**4,368**
Bandera County Total Water Demand	**4,627**	**4,669**	**4,725**	**4,782**	**4,838**	**4,896**
Edwards County - Colorado Basin						
Rocksprings	109	87	70	59	49	39
County-Other	15	12	9	8	7	5
Livestock	62	62	62	62	62	62
Irrigation	103	103	103	103	103	103
Colorado Basin Total Water Demand	**289**	**264**	**244**	**232**	**221**	**209**
Edwards County - Nueces Basin						
Rocksprings	66	53	42	36	30	23
County-Other	36	28	24	19	16	13
Mining	12	12	12	12	12	12
Livestock	256	256	256	256	256	256
Irrigation	128	128	128	128	128	128

Table 2-2. (continued) Plateau Region Water Demand Projections (Ac-ft/yr)

	2030	2040	2050	2060	2070	2080
Nueces Basin Total Water Demand	**498**	**477**	**462**	**451**	**442**	**432**
Edwards County - Rio Grande Basin						
County-Other	7	6	4	4	3	2
Livestock	156	156	156	156	156	156
Irrigation	87	87	87	87	87	87
Rio Grande Basin Total Water Demand	**250**	**249**	**247**	**247**	**246**	**245**
Edwards County Total Water Demand	**1,037**	**990**	**953**	**930**	**909**	**886**
Kerr County - Colorado Basin						
County-Other	96	100	103	108	113	118
Livestock	28	28	28	28	28	28
Irrigation	97	97	97	97	97	97
Colorado Basin Total Water Demand	**221**	**225**	**228**	**233**	**238**	**243**
Kerr County - Guadalupe Basin						
Kerrville	7,839	8,174	8,426	8,829	9,236	9,625
Kerrville South Water	457	475	490	513	537	560
County-Other	3,200	3,332	3,436	3,599	3,765	3,923
Manufacturing	27	28	29	30	31	32
Mining	201	201	201	201	201	201
Livestock	815	815	815	815	815	815
Irrigation	1,865	1,865	1,865	1,865	1,865	1,865
Guadalupe Basin Total Water Demand	**14,404**	**14,890**	**15,262**	**15,852**	**16,450**	**17,021**
Kerr County - Nueces Basin						
County-Other	1	1	1	2	2	2
Livestock	3	3	3	3	3	3
Nueces Basin Total Water Demand	**4**	**4**	**4**	**5**	**5**	**5**
Kerr County - San Antonio Basin						
County-Other	38	40	41	43	45	47
Livestock	43	43	43	43	43	43
Irrigation	66	66	66	66	66	66
San Antonio Basin Total Water Demand	**147**	**149**	**150**	**152**	**154**	**156**
Kerr County Total Water Demand	**14,776**	**15,268**	**15,644**	**16,242**	**16,847**	**17,425**
Kinney County - Nueces Basin						
County-Other	3	3	3	3	3	2
Livestock	49	49	49	49	49	49
Irrigation	2,357	2,357	2,357	2,357	2,357	2,357
Nueces Basin Total Water Demand	**2,409**	**2,409**	**2,409**	**2,409**	**2,409**	**2,408**

Table 2-2. (continued) Plateau Region Water Demand Projections (Ac-ft/yr)

	2030	2040	2050	2060	2070	2080
Kinney County - Rio Grande Basin						
Brackettville	528	499	481	470	459	447
Fort Clark Springs MUD	727	688	663	647	632	616
County-Other	65	61	59	57	56	56
Livestock	193	193	193	193	193	193
Irrigation	4,377	4,377	4,377	4,377	4,377	4,377
Rio Grande Basin Total Water Demand	**5,890**	**5,818**	**5,773**	**5,744**	**5,717**	**5,689**
Kinney County Total Water Demand	**8,299**	**8,227**	**8,182**	**8,153**	**8,126**	**8,097**
Real County - Colorado Basin						
County-Other	3	3	2	2	2	1
Irrigation	17	17	17	17	17	17
Colorado Basin Total Water Demand	**20**	**20**	**19**	**19**	**19**	**18**
Real County - Nueces Basin						
Camp Wood	147	124	106	92	78	64
Leakey	143	121	104	90	77	62
County-Other	210	177	151	131	111	92
Manufacturing	2	2	2	2	2	2
Livestock	261	261	261	261	261	261
Irrigation	308	308	308	308	308	308
Nueces Basin Total Water Demand	**1,071**	**993**	**932**	**884**	**837**	**789**
Real County Total Water Demand	**1,091**	**1,013**	**951**	**903**	**856**	**807**
Val Verde County - Rio Grande Basin						
Del Rio Utilities Commission	12,977	12,985	13,017	13,048	13,079	13,110
Laughlin AFB	969	967	967	967	967	967
County-Other	2,400	2,424	2,455	2,466	2,478	2,490
Manufacturing	8	8	8	8	8	8
Mining	97	105	114	122	129	137
Livestock	492	492	492	492	492	492
Irrigation	4,207	4,207	4,207	4,207	4,207	4,207
Rio Grande Basin Total Water Demand	**21,150**	**21,188**	**21,260**	**21,310**	**21,360**	**21,411**
Val Verde County Total Water Demand	**21,150**	**21,188**	**21,260**	**21,310**	**21,360**	**21,411**
Region J Total Water Demand	**50,980**	**51,355**	**51,715**	**52,320**	**52,936**	**53,522**

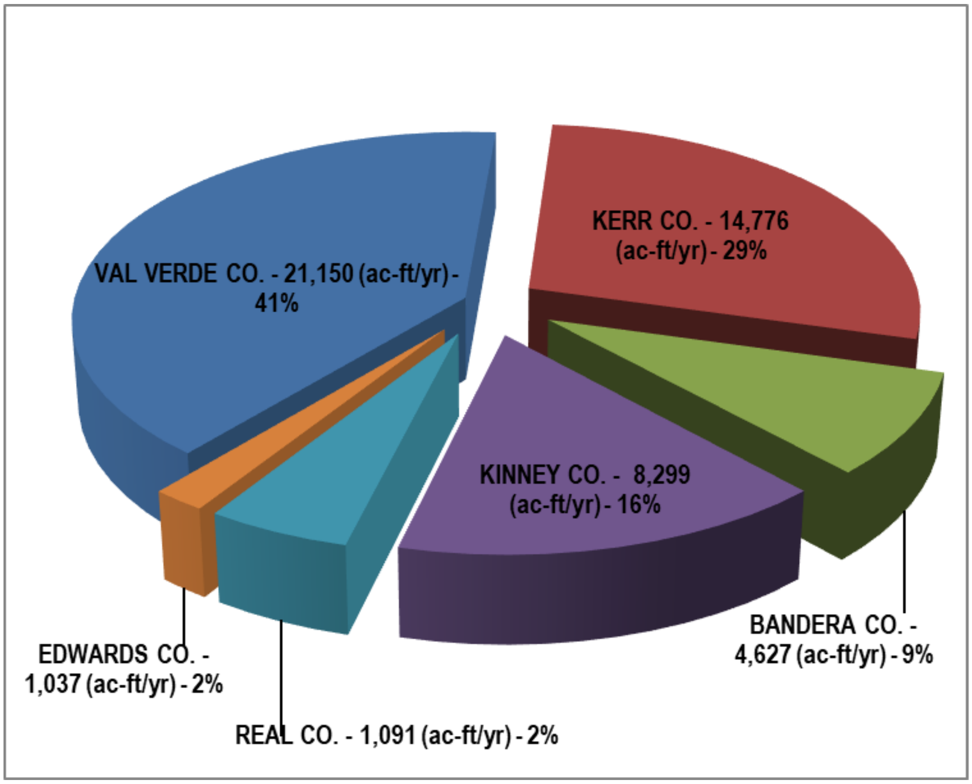

Figure 2-4. Year 2030 Projected Water Demand by County

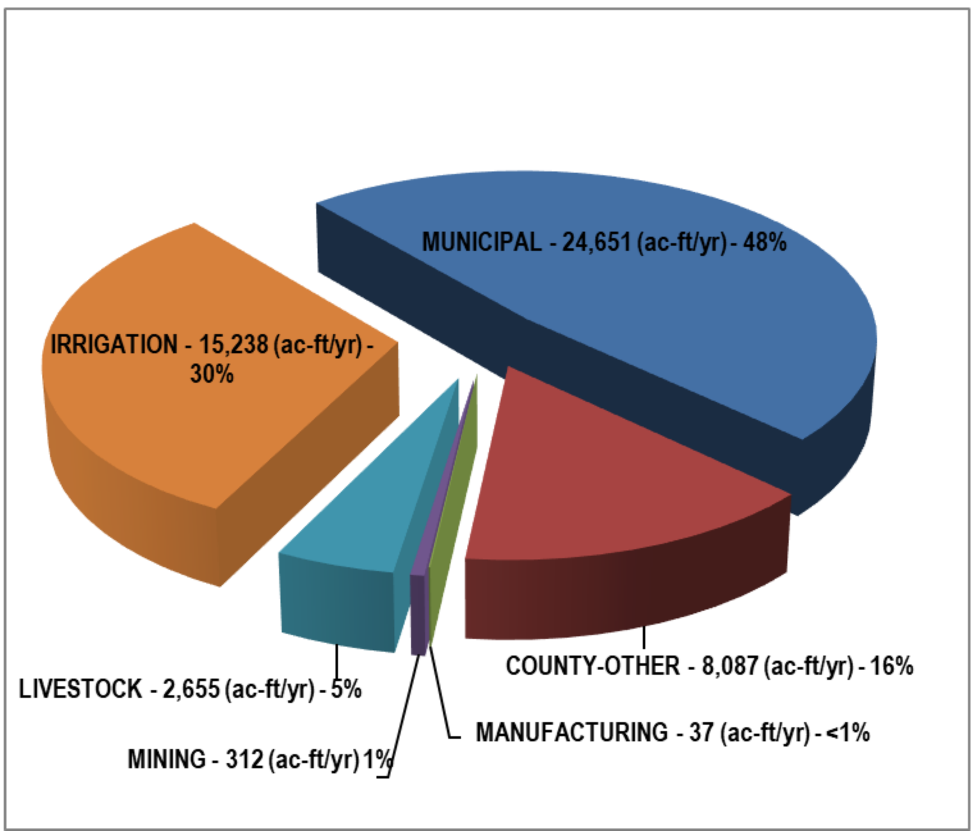

Figure 2-5. Year 2030 Projected Water Demand by Water Use Category

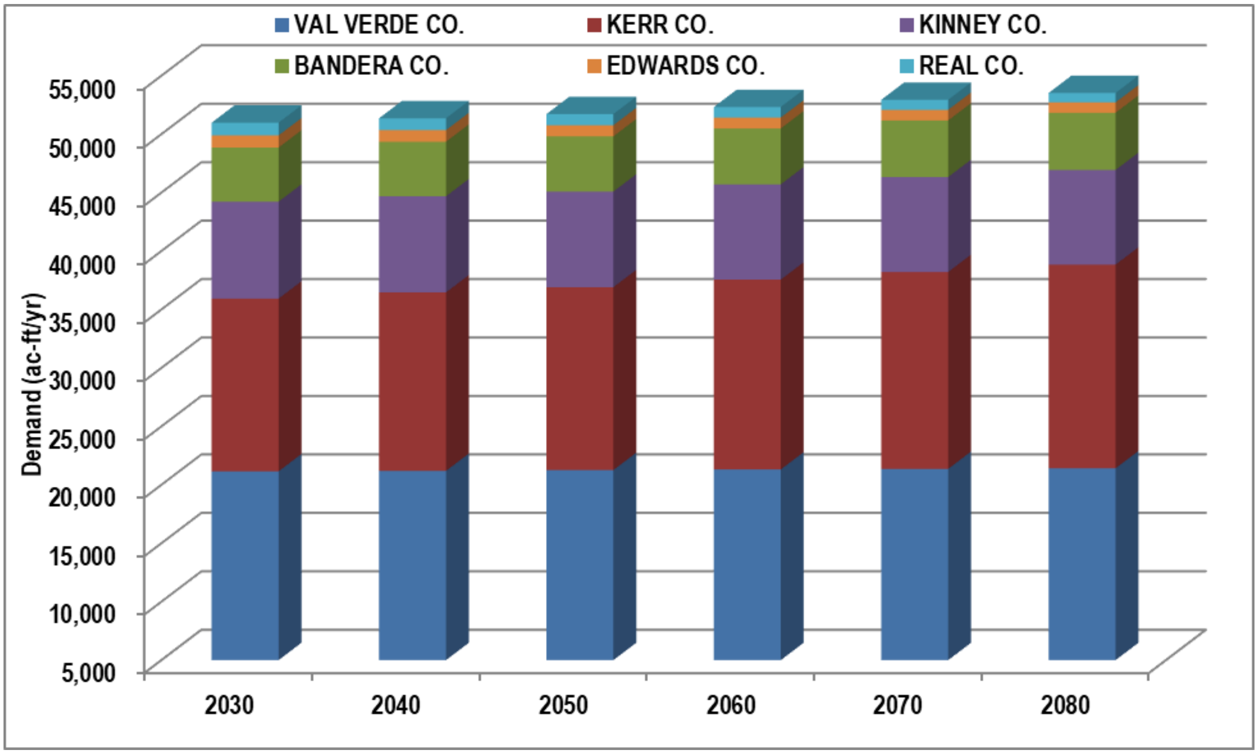

Figure 2-6. Projected Water Demand by County

2.2.2 Municipal and County-Other

The quantity of water used for municipal and county-other is heavily dependent on population growth, climatic conditions, and water conservation measures. For planning purposes, municipal water use comprises both residential and commercial. Commercial water use includes business establishments, public offices, and institutions. Residential and commercial uses are categorized together because they are similar types of uses, i.e., they both use water primarily for drinking, cleaning, sanitation, air conditioning, and landscape watering. Also included in this category is water supplied to golf courses from municipal supply sources. Water use within a utility service area that is not included in the quantification of municipal demand, is that used in manufacturing and industrial processes that are self-supplied.

Municipal and county-other water demand is calculated based on utility service boundaries designated in the population projections process and include rural domestic use. Projected municipal and county-other water demand is based on the year 2020 per-capita water use, which is calculated with year 2020 population counts divided into reported water use for the same year. Per-capita water use in communities with significant non-residential water demands, such as commercial customers, will appear abnormally high. Table 2-3 presents municipal savings due to the expected installation of more water efficient fixtures and appliances. The conservation adjusted per-capita water use is then applied to each of the decade population estimates to produce the projected water demand for each entity. Table 2-4 presents the municipal and county-other projected water use for each decade in the current planning cycle.

Table 2-3. Municipal Savings Due to Plumbing Fixture Requirements (Ac-ft/yr)

County	Entity Name	2030	2040	2050	2060	2070	2080
Bandera	Bandera	11	13	13	13	13	14
	Bandera County FWSD#1	6	6	6	6	6	7
	County-Other	100	113	115	117	120	122
Edwards	Rocksprings	4	3	3	2	2	1
	County-Other	3	2	2	2	1	1
Kerr	Kerrville	191	224	231	242	253	263
	Kerrville South	19	22	23	24	25	26
	County-Other	110	129	133	139	145	152
Kinney	Brackettville	5	6	6	5	5	5
	Fort Clark Springs MUD	8	8	8	8	7	7
	County-Other	3	3	3	3	3	3
Real	Camp Wood	2	2	2	1	1	1
	Leakey	1	1	1	1	1	1
	County-Other	11	10	9	8	6	5
Val Verde	Del Rio	185	208	208	209	209	210
	Laughlin AFB	10	12	12	12	12	12
	County-Other	90	105	106	107	107	108
Total		**758**	**866**	**879**	**898**	**918**	**937**

Municipal (and county-other) water demand in the Plateau Region is projected to increase from 32,731 ac-ft in 2030 to 35,232 ac-ft by 2080 (Table 2-4). Because municipal water demand is directly related to population, Val Verde County has the highest demand in the Region.

Table 2-4. Municipal and County-Other Water Demand Projections (Ac-ft/yr)

County	2030	2040	2050	2060	2070	2080
Bandera	2,702	2,744	2,799	2,856	2,912	2,970
Edwards	226	180	145	122	102	80
Kerr	11,631	12,122	12,497	13,094	13,698	14,275
Kinney	1,323	1,251	1,206	1,177	1,150	1,121
Real	503	425	363	315	268	219
Val Verde	16,346	16,376	16,439	16,481	16,524	16,567
County Total Demand	**32,731**	**33,098**	**33,449**	**34,045**	**34,654**	**35,232**

A significant portion of the municipal water demand in Bandera and Kerr Counties is assigned to the county-other category. This category represents the aggregation of utilities that provide less than an average of 100 ac-ft/yr, as well as rural areas not served by a water utility in a given county. Table 2-5 presents a listing of water systems that comprise the county-other category along with the corresponding Annual WUS data (2015-2019).

Table 2-5. County-Other Water Supply Entities (Ac-ft/yr)

	2015	2016	2017	2018	2019
Bandera County-Other					
Pecan Grove	5	6	5	6	5
Hill Country MHP	-	-	5	5	5
Latigo Ranch Subdivision	4	6	6	7	10
Lakehills Homestead & RV Park	-	0	-	0	0
Summit Ridge	-	-	-	-	14
Medina WSC	98	50	50	42	48
Lake Medina Shores	92	113	117	125	126
Bandera River Ranch 1	65	57	60	61	45
Bandera ISD - Bandera High School	-	-	-	-	-
Bandera ISD - Alkek Elementary	-	-	-	-	-
Bandina	-	-	-	-	-
Bandera Homestead Condominiums	-	-	-	-	-
TPWD Lost Maples SNA	-	-	-	-	-
Enchanted River Estates	54	41	38	38	34
Flying L Ranch PUD	47	52	53	58	58
Lakewood Water	28	28	28	28	28
The Falls WSC	13	15	17	20	16
Ranch Hills WSC	13	14	14	11	10
River Bend Estates	13	16	14	17	15
Blue Medina Water	13	13	13	13	13
Elmwood Estates	10	10	10	10	10

Table 2-5. (continued) County-Other Water Supply Entities (Ac-ft/yr)

	2015	2016	2017	2018	2019
Bear Springs Trails WSC	5	6	10	6	7
Comanche Cliffs	3	12	3	14	3
Medina Highlands	3	3	3	5	5
San Julian Creek Estates	-	0	0	0	0
Medina Childrens Home	13	14	16	19	14
Cielo Rio Ranch Water System	9	-	9	10	13
Bridlegate Subdivision	32	32	38	43	42
Bandera County-Other Total Water Use	**474**	**449**	**451**	**472**	**437**
Edwards County-Other					
Barksdale WSC	15	15	16	17	14
Edwards County-Other Total Water Use	**15**	**15**	**16**	**17**	**14**
Kerr County-Other					
Hermann Sons Home	15	14	14	13	13
Mo-Ranch Presbyterian Assembly	58	53	62	60	61
Forest Oaks MHP	4	4	4	4	4
Heavens MHP	-	-	-	-	-
Silver Hills Park	5	4	6	4	4
Triple T RV Resort	4	7	11	13	7
Sky Harbor Ranchettes Water System	11	13	7	8	5
Saddle Mountain Water Cooperative	13	18	12	15	12
Solar Village HOA	3	4	4	3	3
Fall Branch Estates	5	4	5	6	6
Camp La Junta	11	12	13	12	16
Camp Mystic	14	13	13	12	12
Youth Camps Inc. - Pot O Gold Ranch	6	10	6	7	6
Bonita Homeowners Association	1	2	2	2	1
Buckhorn Lake Resort	10	8	9	19	16
Camp Camp	4	6	5	5	7
Camp Chrysalis	4	3	3	3	3
Camp Rio Vista	13	13	13	13	13
Camp Stewart	20	22	25	20	9
Camp Waldemar	23	26	22	21	27
Johnson Creek RV Resort	2	3	3	4	3
Echo Hill Ranch	1	1	2	2	3
Heart O'the Hills Camp	8	9	9	11	12
Las Colinas of Kerrville	10	11	9	9	11
Hill Country Youth Ranch	13	13	12	12	12
Hillcrest Inn	3	4	5	3	3

Table 2-5. (continued) County-Other Water Supply Entities (Ac-ft/yr)

	2015	2016	2017	2018	2019
LaHacienda Treatment Center	15	16	15	17	19
Hill Country Youth Ranch-Enhanced Horizons	1	1	2	1	3
Starlite Recovery Center	11	12	12	12	8
Camp Tecaboca	3	3	2	3	2
Texas Lions Camp	13	29	16	20	14
USDA Livestock Insect Research Lab	4	2	3	3	3
Hill Country Camp	5	6	7	9	5
Boy Scouts of America	9	11	9	10	7
Hill Country Arts Foundation	1	2	1	2	1
Turtle Creek Industries (Kamp Kickapoo)	0	0	0	1	0
Comanche Trace Ranch	9	4	3	4	4
Ingram Dam Center, LLC	0	0	0	1	2
Camp Verde General Store	3	3	2	2	2
YMCA-Roberts Ranch	0	0	0	0	1
Japonica Hills HOA	6	5	7	10	6
Old River Road RV Resort	0	2	6	9	13
Oak Forest Subdivision	52	45	52	48	65
Westwood Park Water System	24	28	27	28	30
Nickerson Farm Water System	13	37	30	27	21
Verde Park Estates	13	14	16	16	15
Hills & Dales	12	12	12	13	12
Center Point	9	9	10	10	10
Pecan Valley Water System	12	10	12	16	14
Rustic Hills WSC	6	7	7	7	6
Park Place Subdivision	10	9	9	11	10
Kerr County-Other					
Center Point North Water System	20	16	17	18	21
Center Point Taylor System	35	37	37	41	45
Kerrville VA Hospital	56	61	57	52	53
Village West Water System	9	9	8	9	7
Camp Flaming Arrow	5	9	10	8	7
Camp Honey Creek	8	9	11	9	7
Ranchero Estates	6	6	9	8	6
TX Dot Kerr County SRA	4	3	4	4	6
Riverfront MHP	14	18	16	14	14
Ingram Tom Moore High School	17	22	19	16	19
City of Kerrville Schreiner Park	6	12	7	5	6
Armadillo Junction RV Park	2	3	3	3	2

Table 2-5. (continued) County-Other Water Supply Entities (Ac-ft/yr)

	2015	2016	2017	2018	2019
Westcreek Estates Water System	40	47	38	52	54
Ingram Water Supply	480	486	488	568	461
Guadalupe Heights Utility	50	45	49	45	45
Canyon Springs Water Works	53	77	73	43	36
Erlund Subdivision	57	61	69	97	67
Southern Hills	50	52	52	62	59
Woods WSC	38	36	36	35	34
Hunt Community Group WSC	36	24	27	28	26
Bumble Bee Hills	31	31	40	44	40
Mary Mead Water System	34	44	20	26	15
Sleepy Hollow	22	20	20	22	21
Fremount Water Company LLC	25	23	28	27	25
Aqua Vista Utilities Company	25	26	28	29	29
Northwest Hills Subdivision	23	23	22	27	30
Kamira Water System	20	17	18	17	15
Wilderness Park	17	12	13	15	15
Bear Paw Ranch	29	29	30	29	31
Royal Oaks Water	13	12	10	12	14
Hill River Country Estates MHP	13	14	16	15	17
Shalako Water Supply	15	11	12	13	11
Horseshoe Oaks Water System	6	6	6	6	9
Castlecomb Water System	12	10	8	10	10
Four Seasons	88	94	85	88	88
Oak Ridge Estates Water System	8	8	8	9	8
Verde Hills WSC	9	10	11	7	10
Split Rock Water System	6	7	9	8	8
Real Oaks Subdivision	9	8	8	7	14
Heritage Park Water Service	5	5	5	6	6
Cherry Ridge Water Company	6	7	8	6	4
Windwood Oaks Water System	4	4	4	5	5
Shermans Mill WSC	3	5	4	3	3
Vista Hills	2	3	2	3	3
Wood Trail Water Supply	17	17	15	15	17
Woodhaven MHP	5	5	6	7	7
Cedar Springs MHV	6	7	8	7	7
Oak Grove MHP	32	24	24	26	17
Ingram Oaks Retirement Community	35	36	37	35	35

Table 2-5. (continued) County-Other Water Supply Entities (Ac-ft/yr)

	2015	2016	2017	2018	2019
Hill Country Ranch Estates	4	5	5	5	5
Serenity Water LLC	13	15	15	14	10
Kerr County-Other					
Cypress Springs	37	42	37	43	41
Scenic Valley MHP	15	20	20	17	19
Kerr Villa MHP	11	7	3	7	9
Hideaway MHP	7	7	6	7	7
Country Hills Water	3	4	3	4	3
Cherokee MHP	8	6	-	-	-
Blue Ridge MHP	6	10	6	6	11
Falling Water Subdivision	21	24	26	25	21
Saddlewood Subdivision	44	43	49	52	50
Kerr County-Other Total Water Use	**2,170**	**2,282**	**2,243**	**2,384**	**2,207**
Kinney County-Other					
City of Spofford	11	13	12	15	11
Kinney County-Other Total Water Use	**17**	**17**	**17**	**14**	**14**
Real County-Other					
The Ridge at Frio River Water System	-	-	2	2	2
H.E.B. Family Foundation	-	-	-	-	-
Oakmont Village Saddle Mountain WSC	17	16	17	19	20
Real WSC	17	19	21	24	23
Twin Forks Estates WSC	15	16	17	19	17
Frio Canon Water	-	-	-	13	14
Crown Mountain WSC	-	-	5	6	5
Real County-Other Total Water Use	**49**	**51**	**55**	**62**	**60**
Val Verde County-Other					
Holiday Travel L Park	-	-	0	1	1
American Campground	-	-	0	0	12
San Pedro Village	-	-	0	0	0
Rough Canyon Condos	-	-	4	4	9
Langtry WSC	-	-	-	-	-
Amistad Village Water System	-	-	-	-	-
TPWD Seminole Canyon SHP	-	-	-	-	-
Seguro Water Company	-	-	-	-	-
Laughlin AFB Recreation Area	-	-	-	-	-
Val Verde County WCID Comstock	65	66	71	70	72
Upper San Pedro Canyon Subdivision	34	45	42	43	43
Del Grande Mobile Home Association	26	26	23	23	23

Table 2-5. (continued) County-Other Water Supply Entities (Ac-ft/yr)

	2015	2016	2017	2018	2019
La Caleta Estates	18	18	18	18	18
Devils Shores WSC	13	13	15	14	14
Lago Vista Water System	6	6	6	6	6
Lake Ridge Water System	-	0	0	0	0
Val Verde County-Other Total Water Use	**162**	**174**	**175**	**174**	**176**
Region J County-Other Total Water Use	**2,888**	**2,988**	**2,956**	**3,124**	**2,907**

Note: No survey data provided (-)

2.2.3 Major Water Providers

Recent TWDB rule changes (31TAC §357.30(4)) now require regional water planning groups to identify "major water providers" as opposed to "wholesale water providers" (WWPs) as performed in previous plans. An MWP is defined as a significant public or private WUG or WWP whose significance is determined by the RWPG and provides water for any water-use category in a regional water planning area. This rule revision gives regional water planning groups more flexibility in identifying which large water providers ought to be reported in their regional water plan.

The PWPG has developed and adopted the following definition of an MWP and feels that this definition captures all significant municipal WUGs or WWPs that provide water for other water-use categories within the Region.

> ***"An entity that currently provides significant water supplies (>10,000 acre-feet per year) to other users and which will continue to develop new supplies to meet future needs of those whom they supply during the period covered by this Plan."***

Del Rio Utilities is the only entity in the Plateau Region to meet this criterion. In addition to its own use, the utility provides water to Laughlin Air Force Base and subdivisions outside of the City. Del Rio also provides water and wastewater services to two colonias, Cienegas Terrace and Val Verde Park Estates. Table 2-6 shows the distribution of water demand supplied by Del Rio Utilities in the Rio Grande River Basin.

Table 2-6. Del Rio Major Water Provider Water Demand (Ac-ft/yr)

County	Basin	Water User Group	2030	2040	2050	2060	2070	2080
Val Verde	Rio Grande	Del Rio Utilities	12,977	12,985	13,017	13,048	13,079	13,110
		Laughlin AFB (94%)	969	967	967	967	967	967
		County-Other (6%)	2,400	2,424	2,455	2,466	2,478	2,490
Total Wholesale Demand			**16,346**	**16,376**	**16,439**	**16,481**	**16,524**	**16,567**

2.2.4 Manufacturing

Manufacturing water use is one of the three largest uses of water in Texas. In the 2022 State Water Plan, approximately 1.7 million ac-ft was reported within the 2020 planning decade. This represents 10 percent of total water use in the State. In the Plateau Region, manufacturing and industrial water use that is self--supplied is quantified separately from municipal use even though the demand centers may be located within a utility service area. Draft manufacturing water demand projections are based on the highest county aggregated manufacturing water use in the most recent five years (2015 through 2019) of reported Annual WUS data. Values from the WUS used in the max year calculation consist of gross intake (withdrawals and purchases) minus any sales to other entities. Fresh surface water and groundwater were included in this net use. Additionally, volumes of reuse water, such as treated effluent, and brackish groundwater used by manufacturing facilities were included in the historical water-use estimates and the water demand projections. Rather than holding projected demands constant from 2030 through 2080, as seen in the previous water plan, the TWDB projected water demands linearly using the county business patterns (CBP) historical number of manufacturing establishments. In the Plateau Region, the use of water for manufacturing purposes is only recognized in Kerr, Real and Val Verde Counties (Table 2-7).

Table 2-7. Manufacturing Water Demand Projections (Ac-ft/yr)

County	2030	2040	2050	2060	2070	2080
Bandera	0	0	0	0	0	0
Edwards	0	0	0	0	0	0
Kerr	27	28	29	30	31	32
Kinney	0	0	0	0	0	0
Real	2	2	2	2	2	2
Val Verde	8	8	8	8	8	8
County Total Demand	**37**	**38**	**39**	**40**	**41**	**42**

2.2.5 Irrigation

Irrigated agriculture is the biggest user of water in Texas. Approximately 7.5 million ac-ft was represented within the 2020 planning decade, of the 2022 State Water Plan. Irrigation water use represents 45 percent of total water use in the State. This is 10 percent greater than municipal water use, which ranks as the second largest use of water State-wide. On a regional level, irrigation accounts for an estimated 15,238 ac-ft/yr, approximately 84 percent of the total non-municipal water use.

Irrigation water demand projections utilize an average of TWDB's 2015 through 2019 irrigation water-use estimates as a base. Those values are held constant between 2030 and 2080. Annual water-use estimates are developed at the county level by applying a calculated evapotranspiration-based "crop water need" estimate to reported irrigated acreage from the Farm Service Agency (FSA). These estimates are then adjusted based on surface water release data from TCEQ and Texas Water Masters and comments from Groundwater Conservation Districts. In counties where the total groundwater availability over the planning period is projected to be less than the groundwater portion of the baseline water demand projections, the irrigation water demand projections are held constant for 10 years beyond the point that the groundwater availability falls below the baseline demand, in most cases 2030 to 2040, after projected demands will begin to decline, to be compatible with the groundwater availability. However, this approach to a 'groundwater constrained' area presently does not occur in the Plateau Region.

In addition to the TWDB irrigation methodology described above, The PWPG reviewed annual historical water-use estimates spanning across the previous 10 years (2011 through 2020). These estimates are produced using information from the Annual Water-Use Survey and can be found on the TWDB's website.

The revised data shown on Table 2-8 include the maximum annual historical water-use estimates for all counties within the Plateau Region. These values will be held constant throughout the planning horizon (2030 through 2080). This approach was found satisfactory for use in this current regional water plan.

Statewide, irrigation water demands are expected to decline over time. More efficient canal delivery systems have improved water-use efficiencies of surface water irrigation. More efficient on-farm irrigation systems have also improved the efficiency of groundwater irrigation. Other factors that have contributed to decreased irrigation demands are declining groundwater supplies and the voluntary transfer of water rights historically used for irrigation to municipal uses.

Kinney County has the highest irrigation water use in the Region (44 percent). Edwards and Kinney Counties are the only counties in which irrigation use is greater than municipal use (Table 2-8). Elsewhere in the Region, most irrigation that occurs is for the watering of pastures and hay fields. Because of the typically rocky and uneven terrain throughout much of the Region, irrigation of commercial row crops is minimal. On a regional basis, water used for irrigation is projected to be held constant at approximately 15,238 ac-ft/yr over the 50-year planning horizon. However, as any irrigator can attest, climate, water availability, and the market play key roles in how much water is actually applied on a year-by-year basis.

The PWPG is concerned about the accuracy of the irrigation surveys and believes that there is significantly more irrigation water use than is documented. For example, numerous small, irrigated exotic and wildlife feed plots are likely not identified. Also, groundwater used to irrigate golf courses, if not provided by municipalities, may not be accounted for in the irrigation survey estimates. These withdrawals may have a significant impact on local supplies.

Table 2-8. Irrigation Water Demand Projections (Ac-ft/yr)

County	2030	2040	2050	2060	2070	2080
Bandera	1,626	1,626	1,626	1,626	1 ,626	1,626
Edwards	318	318	318	318	318	318
Kerr	2,028	2,028	2,028	2,028	2,028	2,028
Kinney	6,734	6,734	6,734	6,734	6,734	6,734
Real	325	325	325	325	325	325
Val Verde	4,207	4,207	4,207	4,207	4,207	4,207
County Total Demand	**15,238**	**15,238**	**15,238**	**15,238**	**15,238**	**15,238**

2.2.6 Livestock

Texas leads the Nation in the number of farms and ranches, with 248,416 farms and ranches covering 127 million acres (Texas Department of Agriculture, 2023). Although livestock production is an important component of the Texas economy, the industry consumes a relatively small amount of water. A total of 328,950 ac-ft/yr, was the State-wide reported water use in 2020. This represents two percent of total water use in the State. Within the Plateau Region, livestock water use is 15 percent of the total non-municipal water use.

Livestock water demand projections are a combination of an average of the 2015 through 2019 water-use survey information provided by the TWDB, which is based on livestock inventory data from the National Agricultural Statistical Service (NASS) and the Texas Department of Agriculture, and per head water use consumptions by animal class (Table 2-9). County-level water-use estimates are calculated by applying a water use coefficient for each livestock category to county-level inventory estimates. The rate of change for projections from the 2021 Regional Water Plan was then applied to the new base. Many counties chose to hold the base constant throughout the planning horizon. Data highlighted in grey within the *2026 PRWP* column were updates made to the 2021 assumptions, to include the new water use per head coefficients.

Table 2-9. Estimated per Head Daily Water Use Comparison (2021 and 2026 RWPs) (in gallons)

TWDB category	Subcategory	2021 RWP water use (gallons/head/day)	2026 RWP water use (gallons/head/day)
Cattle	Milk	75	55
	Fed & other cattle	15	15
Chickens	Non-broilers	0.086	0.09
	Broilers	0.077	0.09
Turkeys	Turkeys	0.2	0.2
Equine	Horses, ponies, mules, burros, & donkeys	12	12
Hogs	Hogs	11	5
Sheep	Sheep	2	2
Goats	Milk	0.5	2

Source: University of Georgia - College of Agricultural and Environmental Sciences, 2009

For water-supply planning purposes, in the *2026 Plateau Region Water Plan*, livestock water demand is held constant throughout the 50-year planning period. However, reality dictates that during prolonged drought periods, when poor range conditions exist and / or during unfriendly market conditions, livestock herds are generally reduced, thus resulting in significantly less water demand. Kerr County has the greatest livestock water use (889 ac-ft/yr) in the Region (Table 2-10).

In recent years, an expanding use of groundwater in the Region has been to fill and maintain artificial lakes that primarily are intended to add aesthetic value to the property. Although not quantified, the amount of water pumped from local aquifers for this purpose is likely significant and is not reflected in the water demand estimates provided in this chapter. To manage the volume of groundwater used for this purpose, the Headwaters Groundwater Conservation District in Kerr County permits a maximum production of one acre-foot (325,851 gallons) per year.

Exotic game ranching has become commonplace throughout the State and is quite evident in the Plateau Region counties. Bandera and Kerr Counties have the largest population of exotic game in the State (Texas A&M Exotics on the Range). The total number of exotic game likely may equal or even exceed domestic livestock. Yet the livestock water demand projections reported in this *Plan* do not fully reflect this water use.

High game fences that come with the exotic game industry often block the ability of both native and exotic game to access surface water, thus requiring more wells and groundwater use. Groundwater is also often used to irrigate small acreage feed plots for these animals. Future water plans will need to attempt to quantity this specific use and include it in the overall total projected water needs in the State.

In an analysis report prepared for the PWPG in 2010, "Water Use by Livestock and Game Animals in the Plateau Regional Water Planning Area," the amount of water used by various exotic game species is estimated. However, the report states that there is insufficient data on the number of animals in the Region to make an estimate of total use. Estimates made by the Real-Edwards Conservation and Reclamation District find that approximately 602 and 233 ac-ft/yr in Edwards and Real Counties are consumed by exotic game animals.

Table 2-10. Livestock Water Demand Projections (Ac-ft/yr)

County	2030	2040	2050	2060	2070	2080
Bandera	297	297	297	297	297	297
Edwards	474	474	474	474	474	474
Kerr	889	889	889	889	889	889
Kinney	242	242	242	242	242	242
Real	261	261	261	261	261	261
Val Verde	492	492	492	492	492	492
County Total Demand	**2,655**	**2,655**	**2,655**	**2,655**	**2,655**	**2,655**

2.2.7 Mining

Total water use for all purposes in Texas in 2019 was approximately 14.1 million ac-ft/yr. Water use by the mining industry is about 395,000 ac-ft/yr, representing approximately three percent of total water use in the State. In the Plateau Region, mining water use is approximately two percent of the total non-municipal water use. Mining water use is projected to increase slightly over the planning horizon, primarily as a result of increased demand for aggregate industry products.

Although the Texas mineral industry is foremost in the production of crude petroleum and natural gas in the United States, it also produces a wide variety of important nonfuel minerals. In all instances, water is required in the mining of these minerals either for processing, leaching to extract certain ores, controlling dust at the plant site, or for reclamation.

Mining water demand projections were reevaluated in this current cycle of regional water planning. The USGS granted funding to the TWDB for a study on mining use and projections through the Water Use and Research Data Program. Through a contract between TWDB and UTBEG, the 2011-2012 study was updated. The new report titled "Water Use by the Mining Industry in Texas" was published in August of 2022. The goals of this report were to: (1) provide a comprehensive and quantitative assessment of mining water use across Texas, and (2) improve the development process and accuracy of water use estimates and water demand projections. For more information, please read Water Use by Mining Industry in Texas Report.

In Texas, there is an ongoing need for additional fresh water sources, and an unregulated / largely unknown amount of freshwater use occurs in the exploration for oil and gas within the State. The oil and gas industry is strongly encouraged to use brackish and / or recycled water in exploration so that fresh water can be preserved for human needs. Table 2-11 presents the mining water demand projections within the Plateau Water Planning area.

Table 2-11. Mining Water Demand Projections
(Ac-ft/yr)

County	2030	2040	2050	2060	2070	2080
Bandera	2	2	3	3	3	3
Edwards	12	12	12	12	12	12
Kerr	201	201	201	201	201	201
Kinney	0	0	0	0	0	0
Real	0	0	0	0	0	0
Val Verde	97	105	114	122	129	137
County Total Demand	**312**	**320**	**330**	**338**	**345**	**353**

2.3 ENVIRONMENTAL AND RECREATIONAL WATER NEEDS

Environmental and recreational water use in the Plateau Region is not quantified but is recognized as being an important consideration as it relates to the natural community in which the residents of this Region share and appreciate. In Chapter 1, environmental and recreational resources are identified and described. In this section, the water resources needed to maintain these functions are discussed. Water-supply sources that serve environmental needs are characterized in Chapter 3 and potential water-supply strategy consequences on the environment are analyzed in Chapter 5.

All living organisms require water. The amount and quality of water required to maintain a viable population, whether it is plant or animal, is highly variable. While some individuals are capable of migrating long distances in search of water (birds, larger mammals, etc.), others are stationary (plants, fishes, etc.) and must rely on existing supplies.

Natural and environmental resources are often overlooked when considering the consequences of prolonged drought conditions. As water supplies diminish during drought periods, the balance between both human and environmental water requirements becomes increasingly competitive. A goal of this *Plan* is to provide for the health, safety, and welfare of the human community, with as little detrimental effect to the environment as possible. To accomplish this goal, the evaluation of strategies to meet future water needs includes a distinct consideration of the impact that each implemented strategy might have on the environment.

As discussed in Section 2.2.6 (livestock), an expanding use of groundwater in the Region has been to fill and maintain artificial lakes. Although this use may exert stress on the local aquifer system, the resulting impoundments do provide aesthetic value to the property and a water source for wildlife.

Recreational activities that involve human interaction with the outdoors environment are often directly dependent on water resources such as fishing, swimming, and boating; while a healthy environment enhances many others, such as hunting, hiking, and bird watching. Thus, it is recognized that the maintenance of the regional environmental community's water-supply needs serves to enhance the lives of citizens of the Plateau Region as well as the multitude of annual visitors to this Region.

In Chapter 5, each water management strategy contains an environmental impact assessment. A review of these strategies reveals that while some strategies may contain variable levels of negative impact, other strategies may likely have a positive effect. Negative environmental impacts are generally associated with the lowering of aquifer water levels due to increased groundwater withdrawals and its potential to cause a reduction or cessation of spring flow. Also, of concern is that lowered water levels could deplete supplies in shallow livestock wells, which are often the only available source of water for some wildlife. The positive environmental aspect of the strategies is that during severe drought conditions when normal wildlife water supplies may naturally diminish, new supply sources might be developed such that wildlife could benefit. Water-supply availability estimated for surface water management strategies in Chapter 5 follow the modeled application of environmental flow standards in TCEQ 30 TAC Chapter 298 rules or the 1997 Consensus Criteria for Environmental Needs.

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CHAPTER 3
REGIONAL WATER SUPPLY SOURCES

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3 REGIONAL WATER SUPPLY SOURCES

From the semi-arid Hill Country to the arid Rio Grande Basin, both groundwater and surface water are critical resources for the livelihood of the citizens of the Plateau Region and the environment in which they reside. Chapter 3 explores the current and future availability of all water-supply resources in the Region including groundwater, surface water, springs, and reuse. The water demand and supply availability analysis developed in Chapters 2 and 3, respectively, form the basis for identifying in Chapter 4 the areas within the Plateau Region that potentially could experience supply shortages in future years. The following tables list water supplies available to meet future needs (demands) reported in Chapter 2.

- Table 3-1 lists groundwater and surface water availability as estimated in each identified source (aquifer, river, spring) by county and river basin. Water source availability analyses, including water-quality concerns, are discussed in more detail in Section 3.1 (groundwater) and Section 3.2 (surface water).
- Table 3-2 lists water supplies available to municipal utilities and general water-use categories based on the current infrastructure ability of each to obtain water supplies. These abilities primarily include existing infrastructure, water-rights limitations, and GCD permit limitations.
- Table 3-3 lists water supplies available to Del Rio Utilities as an MWP.

Only three municipal utilities within the Plateau Region derive municipal supplies from surface water or spring sources. The City of Kerrville currently uses surface water from the Guadalupe River in conjunction with their groundwater supply. Kerrville also injects excess treated surface water into the Trinity Aquifer through an aquifer storage and recovery (ASR) facility.

The City of Del Rio obtains most of its water supply from San Felipe Springs, which issues from the Edwards limestone. The spring water is treated to drinking water standards in a microfiltration plant prior to distribution. For planning purposes, San Felipe Springs is recognized as a surface water source that falls within the Rio Grande Run-of-River. Currently, due to critically low water levels in the spring, the City of Del Rio has been forced to drill a pilot well approximately 250 feet below the surface in hopes of obtaining a supplemental source of water supply.

Camp Wood in Real County is supplied from Old Faithful Springs on a tributary of the Nueces River. Like the San Felipe Springs, Old Faithful Springs' water levels are also very low due to prolonged drought conditions, making the spring a less reliable water supply source. The City of Camp Wood is working on developing two shallow groundwater alluvium wells that will provide a more reliable source of water supply.

All other communities in the Region are totally dependent on groundwater sources for their supplies. All water supplies based upon contracts are assumed to be renewed.

Table 3-1. Water Source Availability (ac-ft/yr)

	County	Basin	Salinity*	2030	2040	2050	2060	2070	2080
Groundwater									
Austin Chalk Aquifer	Kinney	Nueces	Brackish	875	875	875	875	875	875
Austin Chalk Aquifer	Kinney	Rio Grande	Brackish	1,894	1,894	1,894	1,894	1,894	1,894
Edwards-BFZ Aquifer	Kinney	Nueces	Fresh	6,319	6,319	6,319	6,319	6,319	6,319
Edwards-BFZ Aquifer	Kinney	Rio Grande	Fresh	2	2	2	2	2	2
Edwards-Trinity (Plateau) Aquifer	Bandera	Guadalupe	Fresh	81	81	81	81	81	81
Edwards-Trinity (Plateau) Aquifer	Bandera	Nueces	Fresh	38	38	38	38	38	38
Edwards-Trinity (Plateau) Aquifer	Bandera	San Antonio	Fresh	1,890	1,890	1,890	1,890	1,890	1,890
Edwards-Trinity (Plateau) Aquifer	Kerr	Colorado	Fresh	17	17	17	17	17	17
Edwards-Trinity (Plateau) Aquifer	Kerr	Guadalupe	Fresh	962	962	962	962	962	962
Edwards-Trinity (Plateau) Aquifer	Kerr	Nueces	Fresh	5	5	5	5	5	5
Edwards-Trinity (Plateau) Aquifer	Kerr	San Antonio	Fresh	3	3	3	3	3	3
Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	Edwards	Colorado	Fresh	2,305	2,305	2,305	2,305	2,305	2,305
Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	Edwards	Nueces	Fresh	1,631	1,631	1,631	1,631	1,631	1,631
Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	Edwards	Rio Grande	Fresh	1,740	1,740	1,740	1,740	1,740	1,740
Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	Kinney	Nueces	Fresh	12	12	12	12	12	12
Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	Kinney	Rio Grande	Fresh	70,329	70,329	70,329	70,329	70,329	70,329
Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	Real	Colorado	Fresh	277	277	277	277	277	277
Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	Real	Guadalupe	Fresh	3	3	3	3	3	3
Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	Real	Nueces	Fresh	7,243	7,243	7,243	7,243	7,243	7,243
Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	Val Verde	Rio Grande	Fresh	50,000	50,000	50,000	50,000	50,000	50,000
Ellenburger-San Saba Aquifer	Kerr	Colorado	Fresh	200	200	200	200	200	200
Ellenburger-San Saba Aquifer	Kerr	Guadalupe	Fresh	1,802	1,802	1,802	1,802	1,802	1,802
Frio River Alluvium Aquifer	Real	Nueces	Fresh	2,145	2,145	2,145	2,145	2,145	2,145
Hickory Aquifer	Kerr	Colorado	Fresh	0	0	0	0	0	0
Hickory Aquifer	Kerr	Guadalupe	Fresh	0	0	0	0	0	0
Nueces River Alluvium Aquifer	Edwards	Nueces	Fresh	1,787	1,787	1,787	1,787	1,787	1,787

Table 3-1. (continued) Water Source Availability (ac-ft/yr)

	County	Basin	Salinity*	2030	2040	2050	2060	2070	2080
Nueces River Alluvium Aquifer	Real	Nueces	Fresh	1,787	1,787	1,787	1,787	1,787	1,787
Trinity Aquifer	Bandera	Guadalupe	Fresh	76	76	76	76	76	76
Trinity Aquifer	Bandera	Nueces	Fresh/Brackish	903	903	903	903	903	903
Trinity Aquifer	Bandera	San Antonio	Fresh/Brackish	6,305	6,305	6,305	6,305	6,305	6,305
Trinity Aquifer	Kerr	Colorado	Fresh	318	318	318	318	318	318
Trinity Aquifer	Kerr	Guadalupe	Fresh/Brackish	14,056	13,767	13,450	13,434	13,434	13,434
Trinity Aquifer	Kerr	Nueces	Fresh	0	0	0	0	0	0
Trinity Aquifer	Kerr	San Antonio	Fresh	471	471	471	471	471	471
Trinity Aquifer ASR	Kerr	Guadalupe	Fresh	453	453	453	453	453	453
Groundwater Total Source Availability				**175,929**	**175,640**	**175,323**	**175,307**	**175,307**	**175,307**
Reuse Source Name | Type									
Direct Reuse	Kerr	Guadalupe	Fresh	5,000	5,000	5,000	5,000	5,000	5,000
Direct Reuse	Bandera	San Antonio	Fresh	310	310	310	310	310	310
Reuse Total Source Availability				**5,310**	**5,310**	**5,310**	**5,310**	**5,310**	**5,310**
Surface Water									
Colorado Livestock Local Supply	Real	Colorado	Fresh	0	0	0	0	0	0
Colorado Run-of-River	Edwards	Colorado	Fresh	25	25	25	25	25	25
Guadalupe Livestock Local Supply	Kerr	Guadalupe	Fresh	457	457	457	457	457	457
Guadalupe Run-of-River	Bandera	Guadalupe	Fresh	3	3	3	3	3	3
Guadalupe Run-of-River	Kerr	Guadalupe	Fresh	1,502	1,502	1,502	1,502	1,502	1,502
Medina Lake/Reservoir	Reservoir	San Antonio	Fresh	0	0	0	0	0	0
Nueces Livestock Local Supply	Real	Nueces	Fresh	52	52	52	52	52	52
Nueces Run-of-River	Bandera	Nueces	Fresh	13	13	13	13	13	13
Nueces Run-of-River	Edwards	Nueces	Fresh	94	94	94	94	94	94
Nueces Run-of-River	Real	Nueces	Fresh	1,752	1,752	1,752	1,752	1,752	1,752
Rio Grande Livestock Local Supply	Edwards	Rio Grande	Fresh	77	77	77	77	77	77

Table 3-1. (continued) Water Source Availability (ac-ft/yr)

	County	Basin	Salinity*	2030	2040	2050	2060	2070	2080
Rio Grande Livestock Local Supply	Kinney	Rio Grande	Fresh	49	49	49	49	49	49
Rio Grande Livestock Local Supply	Val Verde	Rio Grande	Fresh	25	25	25	25	25	25
Rio Grande Run-of-River	Kinney	Rio Grande	Fresh	1,035	1,035	1,035	1,035	1,035	1,035
Rio Grande Run-of-River	Val Verde	Rio Grande	Fresh	13,739	13,739	13,739	13,739	13,739	13,739
San Antonio Livestock Local Supply	Bandera	San Antonio	Fresh	73	73	73	73	73	73
San Antonio Run-of-River	Bandera	San Antonio	Fresh	2	2	2	2	2	2
Surface Water Total Source Availability				**18,898**	**18,898**	**18,898**	**18,898**	**18,898**	**18,898**
Region J Source Availability Total				**200,137**	**199,848**	**199,531**	**199,515**	**199,515**	**199,515**

* Salinity field indicates whether the source availability is considered ‘fresh’ (less than 1,000 mg/L), ‘brackish’ (1,000 to 10,000 mg/L), ‘saline’ (10,001 mg/L to 34,999 mg/L), or ‘seawater’ (35,000 mg/L or greater). Sources can also be labeled as ‘fresh/brackish’ or ‘brackish/saline’, if a combination of the salinity types is appropriate.
** Since reservoir sources can exist across multiple counties, the county field value, ‘reservoir’ is applied to all reservoir sources.

New to the sixth cycle of regional water planning, plans must include a single table that lists each local surface water supply with a) an explanation for the basis of the supply itself, and b) the basis for the volume of supply. The table below lists all the local surface water supplies found within Table 3-1, for the Plateau Water Planning Region.

The PWPG acknowledges that the local supplies listed below are confirmed "firm" under DOR. By utilizing the max. historical water use (2011-2021), the PWPG has accounted for availability during droughts. For example, the second worst and second-longest Statewide drought began in August 2010, of which the data below considers.

Surface Water	County	Basin	Salinity	2030	2040	2050	2060	2070	2080	Methodology
Colorado Livestock Local Supply	Real	Colorado	Fresh	0	0	0	0	0	0	N/A
Guadalupe Livestock Local Supply	Kerr	Guadalupe	Fresh	457	457	457	457	457	457	a) Data for the basis of the supply was derived from TWDB Historical Water Use Estimates by County. b) Basis for the volume of supply was derived by taking the max. 11-year historical water use (2011-2021).
Nueces Livestock Local Supply	Real	Nueces	Fresh	52	52	52	52	52	52	a) Data for the basis of the supply was derived from TWDB Historical Water Use Estimates by County. b) Basis for the volume of supply was derived by taking the max. 11-year historical water use (2011-2021).
Rio Grande Livestock Local Supply	Edwards	Rio Grande	Fresh	77	77	77	77	77	77	a) Data for the basis of the supply was derived from TWDB Historical Water Use Estimates by County. b) Basis for the volume of supply was derived by taking the max. 11-year historical water use (2011-2021).
Rio Grande Livestock Local Supply	Kinney	Rio Grande	Fresh	49	49	49	49	49	49	a) Data for the basis of the supply was derived from TWDB Historical Water Use Estimates by County. b) Basis for the volume of supply was derived by taking the max. 11-year historical water use (2011-2021).
Rio Grande Livestock Local Supply	Val Verde	Rio Grande	Fresh	25	25	25	25	25	25	a) Data for the basis of the supply was derived from TWDB Historical Water Use Estimates by County. b) Basis for the volume of supply was derived by taking the max. 11-year historical water use (2011-2021).
San Antonio Livestock Local Supply	Bandera	San Antonio	Fresh	73	73	73	73	73	73	a) Data for the basis of the supply was derived from TWDB Historical Water Use Estimates by County. b) Basis for the volume of supply was derived by taking the max. 11-year historical water use (2011-2021).
Region J Total Livestock Local Supply				**733**	**733**	**733**	**733**	**733**	**733**	

Table 3-2. Existing Supply (ac-ft/yr)

		2030	2040	2050	2060	2070	2080
Bandera County – Guadalupe Basin							
County-Other	Edwards-Trinity (Plateau) Aquifer	31	31	31	31	31	31
Livestock	Edwards-Trinity (Plateau) Aquifer	9	9	9	9	9	9
Guadalupe Basin Total Existing Supply		**40**	**40**	**40**	**40**	**40**	**40**
Bandera County - Nueces Basin							
County-Other	Edwards-Trinity (Plateau) Aquifer	38	38	38	38	38	38
County-Other	Nueces Run-of-River	0	0	0	0	0	0
County-Other	Trinity Aquifer	251	251	251	251	251	251
Mining	Trinity Aquifer	1	1	1	1	1	1
Livestock	Edwards-Trinity (Plateau) Aquifer	0	0	0	0	0	0
Livestock	Trinity Aquifer	44	44	44	44	44	44
Irrigation	Nueces Run-of-River	13	13	13	13	13	13
Irrigation	Trinity Aquifer	326	326	326	326	326	326
Nueces Basin Total Existing Supply		**673**	**673**	**673**	**673**	**673**	**673**
Bandera County - San Antonio Basin							
Bandera	Trinity Aquifer	496	496	496	496	496	496
Bandera County FWSD 1	Trinity Aquifer	439	439	439	439	439	439
County-Other	Edwards-Trinity (Plateau) Aquifer	388	388	388	388	388	388
County-Other	San Antonio Run-Of-River	0	0	0	0	0	0
County-Other	Trinity Aquifer	4,467	4,467	4,467	4,467	4,467	4,467
Mining	Edwards-Trinity (Plateau) Aquifer	2	2	2	2	2	2
Livestock	Edwards-Trinity (Plateau) Aquifer	96	96	96	96	96	96
Livestock	Local Surface Water Supply	73	73	73	73	73	73
Livestock	Trinity Aquifer	74	74	74	74	74	74
Livestock	Direct Reuse	310	310	310	310	310	310
Irrigation	Guadalupe Run-Of-River	3	3	3	3	3	3
Irrigation	San Antonio Run-Of-River	2	2	2	2	2	2
Irrigation	Trinity Aquifer	29	29	29	29	29	29
San Antonio Basin Total Existing Supply		**6,379**	**6,379**	**6,379**	**6,379**	**6,379**	**6,379**
Bandera County Total Existing Supply		**7,092**	**7,092**	**7,092**	**7,092**	**7,092**	**7,092**
Edwards County – Colorado Basin							
Rocksprings	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	806	806	806	806	806	806
County-Other	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	36	36	36	36	36	36
Livestock	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	115	115	115	115	115	115

Table 3-2. (continued) Existing Supply (ac-ft/yr)

		2030	2040	2050	2060	2070	2080
Irrigation	Colorado Run-Of-River	25	25	25	25	25	25
Irrigation	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	78	78	78	78	78	78
Colorado Basin Total Existing Supply		**1,060**	**1,060**	**1,060**	**1,060**	**1,060**	**1,060**
Edwards County - Nueces Basin							
County-Other	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	83	83	83	83	83	83
County-Other	Nueces River Alluvium Aquifer	4	4	4	4	4	4
Mining	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	4	4	4	4	4	4
Livestock	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	203	203	203	203	203	203
Irrigation	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	109	109	109	109	109	109
Irrigation	Nueces Run-of-River	94	94	94	94	94	94
Nueces Basin Total Existing Supply		**497**	**497**	**497**	**497**	**497**	**497**
Edwards County - Rio Grande Basin							
County-Other	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	17	17	17	17	17	17
Livestock	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	113	113	113	113	113	113
Livestock	Local Surface Water Supply	77	77	77	77	77	77
Irrigation	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	72	72	72	72	72	72
Rio Grande Basin Total Existing Supply		**279**	**279**	**279**	**279**	**279**	**279**
Edwards County Total Existing Supply		**1,836**	**1,836**	**1,836**	**1,836**	**1,836**	**1,836**
Kerr County – Colorado Basin							
County-Other	Edwards-Trinity (Plateau) Aquifer	17	17	17	17	17	17
Livestock	Edwards-Trinity (Plateau) Aquifer	0	0	0	0	0	0
Irrigation	Edwards-Trinity (Plateau) Aquifer	0	0	0	0	0	0
Colorado Basin Total Existing Supply		**17**	**17**	**17**	**17**	**17**	**17**
Kerr County - Guadalupe Basin							
Kerrville	Direct Reuse	2,425	2,425	2,425	2,425	2,425	2,425
Kerrville	Ellenburger – San Saba Aquifer	89	89	89	89	89	89
Kerrville	Guadalupe Run-Of-River	150	150	150	150	150	150
Kerrville	Trinity Aquifer	3,277	3,277	3,277	3,277	3,277	3,277
Kerrville	Trinity ASR	453	453	453	453	453	453
Kerrville South Water	Trinity Aquifer	387	387	387	387	387	387
County-Other	Edwards-Trinity (Plateau) Aquifer	397	397	397	397	397	397
County-Other	Guadalupe Run-Of-River	16	16	16	16	16	16
County-Other	Trinity Aquifer	5,111	5,111	5,111	5,111	5,111	5,111

Table 3-2. (continued) Existing Supply (ac-ft/yr)

		2030	2040	2050	2060	2070	2080
Manufacturing	Edwards-Trinity (Plateau) Aquifer	20	20	20	20	20	20
Manufacturing	Guadalupe Run-Of-River	77	77	77	77	77	77
Manufacturing	Trinity Aquifer	0	0	0	0	0	0
Mining	Edwards-Trinity (Plateau) Aquifer	0	0	0	0	0	0
Mining	Guadalupe Run-Of-River	72	72	72	72	72	72
Mining	Trinity Aquifer	54	54	54	54	54	54
Livestock	Edwards-Trinity (Plateau) Aquifer	230	230	230	230	230	230
Livestock	Local Surface Water Supply	457	457	457	457	457	457
Livestock	Trinity Aquifer	143	143	143	143	143	143
Kerr County - Guadalupe Basin							
Irrigation	Guadalupe Run-Of-River	1,187	1,187	1,187	1,187	1,187	1,187
Irrigation	Trinity Aquifer	1,360	1,360	1,349	1,333	1,333	1,333
Guadalupe Basin Total Existing Supply		**15,905**	**15,905**	**15,894**	**15,878**	**15,878**	**15,878**
Kerr County - Nueces Basin							
County-Other	Edwards-Trinity (Plateau) Aquifer	2	2	2	2	2	2
Livestock	Edwards-Trinity Plateau Aquifer	3	3	3	3	3	3
Nueces Basin Total Existing Supply		**5**	**5**	**5**	**5**	**5**	**5**
Kerr County - San Antonio Basin							
County-Other	Edwards-Trinity (Plateau) Aquifer	1	1	1	1	1	1
County-Other	Trinity Aquifer	65	65	65	65	65	65
Livestock	Edwards-Trinity (Plateau) Aquifer	2	2	2	2	2	2
Irrigation	Edwards-Trinity (Plateau) Aquifer	0	0	0	0	0	0
Irrigation	Trinity Aquifer	63	63	63	63	63	63
San Antonio Basin Total Existing Supply		**131**	**131**	**131**	**131**	**131**	**131**
Kerr County Total Existing Supply		**16,058**	**16,058**	**16,047**	**16,031**	**16,031**	**16,031**
Kinney County – Nueces Basin							
County-Other	Edwards-BFZ Aquifer	5	5	5	5	5	5
County-Other	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	1	1	1	1	1	1
Livestock	Edwards-BFZ Aquifer	66	66	66	66	66	66
Livestock	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	11	11	11	11	11	11
Irrigation	Edwards-BFZ Aquifer	2,357	2,357	2,357	2,357	2,357	2,357
Nueces Basin Total Existing Supply		**2,440**	**2,440**	**2,440**	**2,440**	**2,440**	**2,440**

Table 3-2. (continued) Existing Supply (ac-ft/yr)

		2030	2040	2050	2060	2070	2080
Kinney County - Rio Grande Basin							
Brackettville	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	645	645	645	645	645	645
Brackettville	Rio Grande Run-Of-River	0	0	0	0	0	0
Fort Clark Springs MUD	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	1,371	1,371	1,371	1,371	1,371	1,371
County-Other	Austin Chalk Aquifer	65	65	65	65	65	65
County-Other	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	69	69	69	69	69	69
Livestock	Austin Chalk Aquifer	108	108	108	108	108	108
Livestock	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	46	46	46	46	46	46
Livestock	Local Surface Water Supply	49	49	49	49	49	49
Irrigation	Austin Chalk Aquifer	952	952	952	952	952	952
Irrigation	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	3,425	3,425	3,425	3,425	3,425	3,425
Irrigation	Rio Grande Run-Of-River	1,035	1,035	1,035	1,035	1,035	1,035
Rio Grande Basin Total Existing Supply		**7,765**	**7,765**	**7,765**	**7,765**	**7,765**	**7,765**
Kinney County Total Existing Supply		**10,205**	**10,205**	**10,205**	**10,205**	**10,205**	**10,205**
Real County – Colorado Basin							
County-Other	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	9	9	9	9	9	9
Irrigation	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	20	20	20	20	20	20
Colorado Basin Total Existing Supply		**29**	**29**	**29**	**29**	**29**	**29**
Real County - Nueces Basin							
Camp Wood	Nueces Run-of-River	0	0	0	0	0	0
Leakey	Frio River Alluvium Aquifer	577	577	577	577	577	577
County-Other	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	176	176	176	176	176	176
County-Other	Frio River Alluvium Aquifer	352	352	352	352	352	352
County-Other	Nueces River Alluvium Aquifer	1	1	1	1	1	1
County-Other	Nueces Run-of-River	0	0	0	0	0	0
Manufacturing	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	0	0	0	0	0	0
Livestock	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	209	209	209	209	209	209
Livestock	Local Surface Water Supply	52	52	52	52	52	52
Irrigation	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	192	192	192	192	192	192
Irrigation	Nueces Run-of-River	1,752	1,752	1,752	1,752	1,752	1,752
Nueces Basin Total Existing Supply		**3,311**	**3,311**	**3,311**	**3,311**	**3,311**	**3,311**
Real County Total Existing Supply		**3,340**	**3,340**	**3,340**	**3,340**	**3,340**	**3,340**

Table 3-2. (continued) Existing Supply (ac-ft/yr)

		2030	2040	2050	2060	2070	2080
Val Verde County – Rio Grande Basin							
Del Rio Utilities	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	0	0	0	0	0	0
Del Rio Utilities	Rio Grande Run-Of-River	7,461	7,461	7,461	7,461	7,461	7,461
Laughlin AFB	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	0	0	0	0	0	0
Laughlin AFB	Rio Grande Run-Of-River	1,080	1,080	1,080	1,080	1,080	1,080
County-Other	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	2,632	2,632	2,632	2,632	2,632	2,632
County-Other	Rio Grande Run-Of-River	360	360	360	360	360	360
Manufacturing	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	8	8	8	8	8	8
Mining	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	99	99	99	99	99	99
Livestock	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	467	467	467	467	467	467
Livestock	Local Surface Water Supply	25	25	25	25	25	25
Irrigation	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer	143	143	143	143	143	143
Irrigation	Rio Grande Run-Of-River	4,207	4,207	4,207	4,207	4,207	4,207
Rio Grande Basin Total Existing Supply		**16,482**	**16,482**	**16,482**	**16,482**	**16,482**	**16,482**
Val Verde County Total Existing Supply		**16,482**	**16,482**	**16,482**	**16,482**	**16,482**	**16,482**
Region J Total Existing Supply		**55,013**	**55,013**	**55,002**	**54,986**	**54,986**	**54,986**

Note: All county-other totals are assumed to be equally distributed throughout the rural portion of each county, whereas in reality, county-other population, water demand and existing water supplies are often concentrated in smaller areas of the county, such as unincorporated communities, subdivisions, and mobile home parks.

Table 3-3. Del Rio Utilities Major Water Provider Supply (ac-ft/yr)

County	Basin	Major Water Provider	Receiving Entity	2030	2040	2050	2060	2070	2080
Val Verde	Rio Grande	Del Rio Utilities	City of Del Rio	6,021	6,021	6,021	6,021	6,021	6,021
			Laughlin AFB	1,080	1,080	1,080	1,080	1,080	1,080
			County Other	360	360	360	360	360	360
Total Wholesale Supply				**7,461**	**7,461**	**7,461**	**7,461**	**7,461**	**7,461**

3.1 GROUNDWATER RESOURCES

The principal aquifers in the Plateau Region are the Trinity, Edwards-Trinity (Plateau), Edwards (Balcones Fault Zone), Austin Chalk, Frio, Nueces River Alluviums, and, the Ellenburger-San Saba Aquifer (Figure 3-1). Aquifer descriptions provided in this Chapter are relatively limited; more detailed hydrogeological characterization of the aquifers may be obtained from reports published by the TWDB, USGS, UTBEG, and other agencies and universities. The water quality of aquifers is relatively good and a detailed discussion on water-quality characteristics and issues is provided in Chapter 1, Section 1.4.5.

Two water-source characterization studies were conducted during a previous planning period. The first study, “Occurrence of Significant River Alluvium Aquifers in the Plateau Region, 2010” identifies and quantifies viable groundwater sources in shallow alluvial aquifers that parallel many of the major streams in the Region. As a result of the study, substantial volumes were estimated for the Frio and Nueces River Alluvium Aquifers in Real and Edwards Counties.

The second study, “Groundwater Data Acquisition in Edwards, Kinney and Val Verde Counties, Texas, 2009” was performed to assist in the further characterization of the Edwards and associated aquifers in the western part of the Plateau Region. The project included four general tasks: (1) review of existing aquifer evaluations, field studies and new well data, (2) performance of dye tracer tests to analyze groundwater flow direction and speed, (3) measurement of water levels in wells during two seasonal periods, and (4) review of recent water quality sampling projects. These two reports can be viewed on the Plateau Water Planning Group (PWPG) website.

The Ellenburger-San Saba Aquifer was added to the previous plan as a new source. During this cycle of regional water planning, there was a test hole exploration, pumping test results, and water chemistry analysis which verified that this Aquifer does provide a potential source of water that can meet the supply needs of northeastern Kerr County. In 2023, the City of Kerrville assumed ownership of the new Ellenburger production well, which produced approximately 89 ac-ft.

Over much of the Region, water levels generally fluctuate with seasonal precipitation and are highly susceptible to declines during drought conditions. Water levels generally recover during wet periods; however, a long-term decline is being observed in some Trinity Aquifer wells in the eastern portion of the Region where pumping is exceeding the capacity of the local Aquifer to fully recharge.

Discharge from the aquifers occurs naturally through springs and artificially by pumping from wells. Some discharge also occurs through leakage from one water-bearing unit to another and through natural down-gradient flow out of the Region.

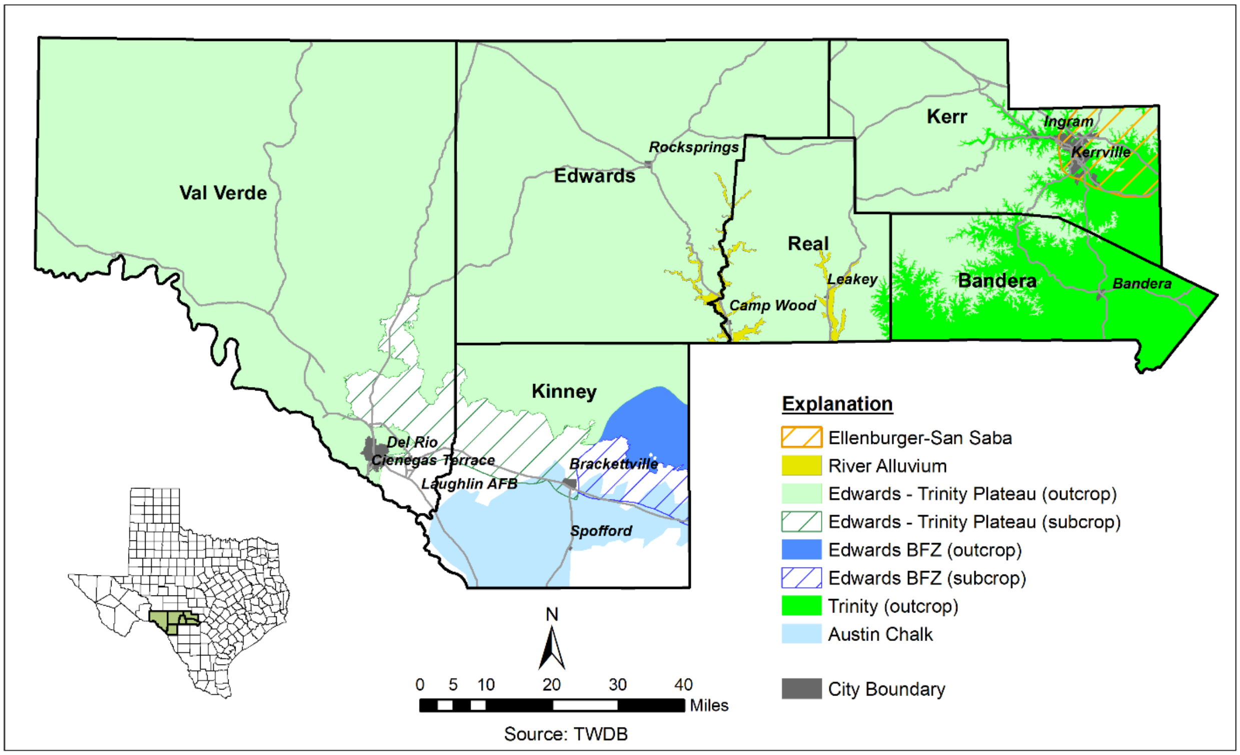

Figure 3-1. Groundwater Sources

3.1.1 Groundwater Availability

Base flow to the many rivers and streams that flow through the Plateau Region is principally generated from the numerous springs that issue from rock formations that form the major aquifers in the Region. The Plateau Region contains the headwaters of the Guadalupe, San Antonio, Medina, Sabinal, Frio, Nueces, and West Nueces Rivers; and tributaries to the Rio Grande and Colorado River such as the Pecos, Devils, and South Llano Rivers. Flow in these rivers and streams is critical to the Plateau Region in that it provides municipal drinking water, supplies irrigation and livestock needs, maintains environmental habitat, and supports a thriving ecological and recreational tourist economy. Water users downstream of the Plateau Region (Regions K, L, and M) likewise have a stake in maintaining and protecting spring-fed base flows of rivers that originate in the Plateau Region.

It is thus recognized that sustaining flow in these important rivers and streams is highly dependent on maintaining an appropriate water level in the aquifer systems that feed the supporting springs. With the sustainability of local water supplies and the economic welfare of the Region in mind, the PWPG defines groundwater availability, “as a maximum level of aquifer withdrawal that results in an acceptable level of long-term aquifer impact such that the base flow in rivers and streams is not significantly affected beyond a level that would be anticipated due to naturally occurring conditions.” In so defining groundwater availability, the planning group establishes a policy decision to protect the long-term water supply and related economic needs of the Plateau Region. The PWPG acknowledges and supports GCD’s regulatory authority over permitted withdrawals from aquifers within their respective boundaries.

Groundwater availability as listed on Table 3-1 in this *2026 Plateau Region Water Plan* is based on the MAG volumes that may be produced on an average annual basis to achieve a DFC as adopted by GMAs (per Texas Water Code §36.001). The GMA process is explained in more detail in Chapter 1, Section 1.1.5. Groundwater availability for these sources is calculated by modeling or standard geohydrologic methods. Table 3-4 lists the methodology used to calculate groundwater source availability.

Table 3-4. Groundwater Availability Methodology

Source Supply	County	Basin	Methodology
Austin Chalk Aquifer	Kinney	Rio Grande	0.6% (0.006) of average annual rainfall (22 in) over the aquifer outcrop (189,377 acres) as recharge. Calculated by Planning Group consultant (Carollo).
		Nueces	Not an official TWDB aquifer and not modeled. Total availability values of 875 ac-ft/yr are from RWP22 Database with a source description based on Robert Bradley's analysis of the number of wells in the TWDB Groundwater Database. GMA10
Nueces River Alluvium Aquifer	Edwards	Nueces	Recharge plus 0.1 volume of water in storage. See Plateau Region Report: Occurrence of Significant River Alluvium Aquifers in the Plateau Region (2010). www.ugra/plateau-water-planning-group
	Real	Nueces	
Frio River Alluvium Aquifer	Real	Nueces	
Ellenburger/San Saba Aquifer	Kerr	Colorado	Annual availability of 0.007 ac-ft/acre/year over 286,000 acres of prime production zone in eastern Kerr County. See Sec 3.1.8 of this 2026 Plan.
		Guadalupe	
Edwards-BFZ Aquifer	Kinney	Nueces	GMA10 MAG
		Rio Grande	
Edwards Group of the Edwards-Trinity (Plateau) Aquifer	Kerr	Colorado	GMA9 Non-Relevant, TWDB modeled run compatible with DFC, which was provided to PWPG.
		Guadalupe	
		Nueces	
		San Antonio	
	Bandera	Guadalupe	GMA9 MAG
		Nueces	
		San Antonio	
Edwards-Trinity (Plateau), Pecos Valley, Trinity Aquifer	Edwards	Colorado	GMA7 MAG
		Nueces	
		Rio Grande	
	Kinney	Nueces	
		Rio Grande	
	Real	Colorado	
		Nueces	
		Guadalupe	
		Rio Grande	

Table 3-4. (continued) Groundwater Availability Methodology

Source Supply	County	Basin	Methodology
Trinity Aquifer	Bandera	Guadalupe	GMA9 MAG
		Nueces	
		San Antonio	
	Kerr	Colorado	
		Guadalupe	
		Nueces	
		San Antonio	

3.1.2 Trinity Aquifer

Located mostly in the Hill Country counties of Bandera and Kerr, the Trinity Aquifer system is composed of deposits of sand, clay and limestone of the Glen Rose and Travis Peak formations of the Lower Cretaceous Trinity Group where they are not overlain by Edwards Limestone. Limited exposures of Trinity also occur in southern Edwards and Real Counties. The water-bearing units include, in descending order, the Glen Rose Limestone, Hensell Sand, Cow Creek Limestone, Sligo Limestone and Hosston Sand. The Glen Rose formation is divided informally into upper and lower members. Based on their hydrologic relationships, the water-bearing rocks of the Trinity Group, collectively referred to as the Trinity Aquifer system, are organized into the following aquifer units.

- Upper Trinity Aquifer - Upper member of the Glen Rose Limestone.
- Middle Trinity Aquifer - Lower Member of the Glen Rose Limestone, Hensell Sand and Cow Creek Limestone.
- Pine Island / Hammet Shale - confining bed.
- Lower Trinity Aquifer - Sligo Limestone and Hosston Sand.

Because of fractures, faults, and other hydrogeological factors, the Upper, Middle and Lower Trinity Aquifer units often are in hydraulic communication with one another and collectively should be considered a leaky-aquifer system.

3.1.2.1 Upper and Middle Trinity Aquifer

The upper member of the Glen Rose, when weathered on the land surface, creates the distinctive "stair-step" topography found throughout the hilly train of the Hill Country. The upper Glen Rose, which forms the Upper Trinity Aquifer, often contains water with total dissolved solids (TDS) often exceeding 1,000 milligrams per liter (mg/L), especially in wells that penetrate “gyp” (evaporite) beds. Water percolating through evaporite beds tends to be high in sulfate and generally should be sealed off in a well. Upper Trinity wells are generally shallow and are mostly used for domestic and livestock purposes.

The Middle Trinity Aquifer, consisting of lower Glen Rose, Hensell, and Cow Creek formations, generally contains TDS of less than 1,000 mg/L. In the Hill Country region, the primary contribution to poor water-quality occurs in wells that do not adequately case off water from evaporite beds in the upper part of the Glen Rose (Upper Trinity Aquifer). Water levels in Upper and Middle Trinity wells fluctuate with seasonal precipitation and are highly susceptible to declines during drought conditions. Radium has been detected in some Trinity wells in Kerr County.

Due to prolonged drought conditions, well spacing within the Middle Trinity Aquifer, in both Kerr and Bandera Counties have increased from three acres to 10 acres. Water well spacing is significant because it directly impacts the sustainability of groundwater extraction by preventing excessive drawdown of the water table. During a drought, water well spacing becomes more critical as lower groundwater levels due to reduced rainfall can lead to increased competition between nearby wells, potentially causing one well to draw down the water table too low if they are positioned too close together.

Furthermore, it should be noted that the volume of water represented on Table 3-1 for the Trinity Aquifer in both Bandera and Kerr Counties, specific to county-other are totals assumed to be equally distributed throughout the rural portion of each county, whereas in reality, county-other population and water demand are often concentrated in smaller areas of the county, such as unincorporated communities, subdivisions and mobile home parks. Concentration of rural population in the eastern portions of both Kerr and Bandera Counties are discussed further in Section 2.1.2.

Lastly, the Middle Trinity Aquifer covers only a portion of both Bandera and Kerr Counties (Figure 3-1), making it very challenging to identify drilling locations where water wells will be productive and can provide a good source of additional water supply.

3.1.2.2 Lower Trinity Aquifer in Bandera and Kerr Counties

Separating the Middle and Lower Trinity is the Hammett Shale (sometimes referred to as the Pine Island Shale). The approximately 60-foot-thick formation acts as a confining bed, or barrier to cross-formational flow in most areas, and thus divides the producing sections of the Middle and Lower Trinity Aquifer units.

The Lower Trinity Aquifer is composed of sandy limestone, sand, clay and shale of the Sligo and Hosston formation. The Lower Trinity thins toward the northeast and is completely missing or coalesces with upper Trinity units near the Llano Uplift. The Lower Trinity is principally a water-supply source for the Cities of Bandera and Kerrville and for a few private water-supply companies and resorts.

Yields from wells completed into the Lower Trinity are generally unpredictable and vary greatly. The greater depth and difficulty of sealing off the Hammett Shale make completing wells into the Lower Trinity more difficult and more expensive. However, in some areas, the Lower Trinity has higher yields and better water quality than shallower aquifers. Recharge to the Lower Trinity in Bandera and Kerr Counties likely occurs primarily by lateral underflow from the north and west. The overlying Hammett Shale mostly prevents vertical movement of water downward except possibly in highly fractured or faulted areas.

3.1.3 Edwards-Trinity (Plateau) Aquifer

The Edwards-Trinity (Plateau) Aquifer consists of lower Cretaceous age saturated limestone and dolomite formations of the Edwards Group and underlying sediments of the Trinity Group where they occur underlying the Edwards Plateau. The upper Edwards portion of the aquifer system is generally more porous and permeable than the underlying Trinity. Numerous springs that form the headwaters of several eastward and southerly flowing rivers, occur where the contact between the base of the Edwards and the top of the Trinity is exposed at the land surface. See Section 3.3 for a more detailed discussion pertaining to groundwater / surface water relationship.

In Kinney and Val Verde Counties, the Edwards Aquifer consists of groundwater contained in the Salmon Peak and McKnight units of the Devils River Limestone. Aquifer thickness is as much as 1,000 feet. San Felipe and Los Moras Springs in Val Verde and Kinney Counties issue from the Edwards and is the primary municipal supply source for the City of Del Rio.

Recharge to the aquifer occurs primarily by the downward percolation of surface water from streams draining off the Edwards Plateau to the north and west and by direct infiltration of precipitation on the outcrop. Some water enters the Region in the aquifer as underflow from counties up gradient (generally north).

The Glen Rose Limestone is the primary unit in the underlying Trinity in the southern part of the Plateau. The Aquifer generally exists under water-table conditions; however, where the Glen Rose is fully saturated and a zone of low permeability occurs near the base of the overlying Edwards, artesian conditions exist.

Reported well yields commonly range from less than 50 gallons per minute (gpm) where saturated thickness is thin to more than 1,000 gpm where large-capacity wells are completed in jointed and cavernous limestone. There are little pumping withdrawals from the Aquifer over most of its extent, and water levels have generally fluctuated only with seasonal precipitation. In some local instances, water levels have declined as a result of increased pumping.

3.1.4 Edwards (BFZ) Aquifer

In the Plateau Region, the Edwards-BFZ Aquifer is designated only in eastern Kinney County at its westernmost extent. The Edwards portion of the Edwards-Trinity (Plateau) Aquifer and the Edwards of the Edwards (BFZ) Aquifer are the same geologic formation, and their boundary is arbitrarily established by the TWDB. There is no significant hydrologic boundary between the outcrops of these two aquifer systems, thus groundwater in the Edwards-Trinity freely moves down gradient into the Edwards (BFZ).

The Edwards (BFZ) Aquifer exists under water-table conditions in the outcrop and under artesian conditions where it is confined below the overlying Del Rio Clay in its downdip extent. Water in the Aquifer generally moves from the recharge zone toward natural discharge points such as Las Moras Springs at Brackettville. Additional water is lost from the Kinney County area as underflow that leaves the County to the east into Uvalde County (Region L). Very little pumping has occurred from this Aquifer in Kinney County, and therefore water levels have remained relatively constant with only minor changes over time.

3.1.5 Austin Chalk Aquifer

The Austin Chalk Aquifer occurs in the southern half of Kinney County primarily south of Highway 90. A veneer of sand and gravel deposits cover much of the southwest portion of Kinney County, which provides a soil base for agricultural production. Crops grown in this area are irrigated with mostly brackish quality groundwater pumped from the underlying Austin Chalk Aquifer. Much less production is apparent in the Nueces River Basin in the eastern part of the County. Recharge to the Austin Chalk is from precipitation and stream loss over the outcrop area and likely from Edwards Aquifer underflow through faults located up-gradient.

A wide range of production rates exists for wells completed in the Austin Chalk. The best production from the Aquifer occurs in areas that have been fractured or contain numerous solution openings. Most wells only discharge enough water for domestic or livestock use, but a few wells are large enough for irrigation purposes. The largest reported yield for an Austin Chalk well in Kinney County is 2,000 gpm (Bennett and Sayre, 1962). Most of the more productive wells completed in the Austin Chalk are located along Las Moras Creek.

3.1.6 Frio River Alluvium Aquifer

The Frio River Alluvium in central Real County extends over an area of approximately 9,530 acres. Recharge to the Aquifer is from cross-formational flow from the adjacent Edwards-Trinity Aquifer and direct infiltration of precipitation. Water supplies for the City of Leakey and other rural domestic homes are derived from this small Aquifer. Because of the limited extent of this Aquifer and its shallow water table, the aquifer system is readily susceptible to diminished supplies during drought conditions and potentially from over pumping. Also, due to its shallow nature, the Aquifer is susceptible to contamination from surface sources.

3.1.7 Nueces River Alluvium Aquifer

The Nueces River Alluvium between Edwards and Real Counties extends over an area of approximately 24,450 acres. Recharge to the Aquifer is from cross-formational flow from the adjacent Edwards-Trinity Aquifer and direct infiltration of precipitation. Water supplies for the Community of Barksdale and rural domestic homes are derived from this small Aquifer. As with the Frio Alluvium, the Nueces River Alluvium Aquifer is readily susceptible to diminished supplies during drought conditions and potentially from over pumping, and to contamination from surface sources.

3.1.8 Ellenburger – San Saba Aquifer

Recent advances in aquifer research have suggested the desirability of adding the Ellenburger-San Saba Aquifer in Kerr County to the list of available groundwater sources in the Plateau Planning Region. In December 2016, an exploration test well (Headwaters GCD Monitor Well No. 17) in the northeast corner of Kerr County was completed in the Ellenburger Limestone to a total depth of 1,153 feet below ground level. A subsequent 24-hour pumping test was performed on the test well, which produced 600 gpm with 69 feet of drawdown. The results suggest a transmissivity range of 7,920 to 12,670 gpd/ft. Water samples were collected and analyzed for chemical quality. TDS are 498 mg/L and all constituents are within both primary and secondary drinking-water standards.

In September 2020, the Headwater GCD contracted with Wet Rock Groundwater Services (WRGS), to further explore the groundwater resources of the geologic units beneath the Trinity Aquifer, specifically the units in the Llano Uplift Aquifer System, and ultimately to provide public supply to the City of Kerrville. McKinley Drilling completed Well No. 19 in July 2020 to TCEQ public water supply well standards. Upon completion of the well, both McKinley Drilling and WRGS coordinated to perform a

36-hour aquifer test on Well No. 19 while utilizing the nearby City of Kerrville ASR Well No. 3 as an observation well.

During the 36-hour aquifer test, Well No. 19 was pumped at an average rate of 793 gpm with an initial pumping rate of 800 gpm and a final pumping rate of 772 gpm with 153.4 feet of drawdown, resulting in a specific capacity of 5.03 gpm/ft. Approximately 24-hours after the pump started, the pumping rate was reduced to 772 gpm to ensure the water level did not reach the pump. During the test, the water level dropped approximately 135 feet within the first 12-hours of pumping, then slowly declined and oscillated throughout the remainder of the pumping phase. After the pump was shut off, recovery was measured in the pumping well for approximately three hours; during that time, the water level recovered by approximately 86 percent (Report of Findings: Aquifer Test Results of the Headwaters GCD Monitoring Well No. 19, 2020).

Well No. 19 is completed within the Ellenburger Formation of the Ellenburger-San Saba Aquifer, where the well is screened in the most productive zone within the formation, which is between 615 and 710 feet below ground level, according to the geologists from the Headwater GCD. Ownership of Well No. 19 eventually transferred to the City of Kerrville and in 2023, the well produced a total of 89 ac-ft. This well is now an active production well for their public water system.

Groundwater Management Area 9 (GMA9), along with the Headwater GCD, is currently working with Jerry Shi and others, on updating the TWDB Llano Uplift Groundwater Availability Model (LUGAM) to include the Ellenburger-San Saba Aquifer within layer five. This modification to the model will classify the Ellenburger-San Saba Aquifer in Kerr County as relevant. During the next round of GMA planning, GMA9 will agree on a DFC and submit that data to the TWDB. Based on the approved DFC, the TWDB will then issue a MAG volume for the inclusion of the next round of regional water planning.

For Regional Water Planning purposes, it is proposed that the *2026 Plateau Region Plan* will adopt a conservative Ellenburger-San Saba Aquifer availability rate of 0.007 ac-ft/acre/year over the 286,000-acre productive area or a total of 2,002 ac-ft/yr. This volume is subdivided between the Colorado and Guadalupe River basins in eastern Kerr County into 200 ac-ft/yr and 1,802 ac-ft/yr respectfully.

3.1.9 Public Supply Use of Groundwater

All communities in the Plateau Region rely partially or completely on groundwater supply sources. Even the spring sources (classified as surface water) used by Del Rio and Camp Wood originate from aquifers. The higher concentration of wells in Kerr and Bandera Counties related to population growth may present water supply availability problems in the future. Public supply wells serving communities in Edwards, Kinney, Real and Val Verde Counties are not anticipated to have long-term declines due to the relatively smaller quantities of water that are needed to serve these communities. Also, no long-term water-quality deterioration has been detected in groundwater supplies for these communities. Long-term viability of the aquifers serving these other communities appears to be acceptable. However, new wells should be located outside the local areas of pumping influence of the existing wells.

Although no evidence of contamination from surface sources have been detected in public-supply groundwater sources in the Plateau Region, a wellhead protection program should be considered by all communities.

3.1.9.1 City of Bandera

The City of Bandera is primarily dependent on wells completed into the Lower Trinity Aquifer and must compete for this water with numerous private wells in the County. However, a new Middle Trinity well was recently completed, which will provide some backup to the Lower Trinity well supply. Long-term viability of the Trinity Aquifer as a supply source for Bandera and outlying areas will require implementation of management policies aimed at establishing withdrawals based on the sustainable yield of the Aquifer.

In February of 2023, the City of Bandera completed an ASR report. The ASR Report: Longevity Assessment for the City of Bandera Water Wells provides the City with options to enhance and manage current resources along with developing other water supply sources besides groundwater. The purpose of the ASR strategy is to help maintain reliably recoverable water levels, increase the longevity of the City's wells, and supply reserves for times of drought.

City of Bandera Well No. 69-24-202 shows a consistent decline from the 1950s through the 1990s, with a total of approximately 400 feet of water level decline. Most of the water withdrawn by Bandera public supply wells is produced from the Lower Trinity (Hosston) which receives very little vertical recharge and an undetermined amount of lateral underflow from the north and west of the well fields. Because of the continuous water-level decline in these well fields, the City, with the assistance of the Bandera County River Authority and Groundwater District (BCRAGD), should monitor levels to anticipate production reductions.

3.1.9.2 Bandera County FWSD No. 1

Bandera County FWSD No. 1 provides water to the Pebble Beach subdivision and obtains its water from wells completed in the Trinity Aquifer. This District currently has four active wells and competes for this water with numerous private wells within the County. Growing subdivisions will increase water demands, causing the District to consider the need for additional supply.

3.1.9.3 City of Kerrville

The City of Kerrville is dependent on conjunctive use of surface water from the Guadalupe River, groundwater from Lower Trinity Aquifer wells and one new production well within the Ellenburger-San Saba Aquifer. Kerrville Wells No. 4 and No. 11 experienced declines of as much as 200 feet through the early to mid-1980s. Between the early to mid-1980s and the early 1990s, water levels in these two wells increased by as much as 200 feet in response to the decreased pumpage by the City when surface water sources were brought on-line. Since 1998, water levels have remained relatively constant.

The only long-term water-quality degradation trend observed in Kerrville public-supply wells is noted in the increase in sodium, chloride, and TDS in the City's Travis Well No. 14 during the late 1960s to mid-1970s. The well showed steady increases in sodium (18 to 72 mg/L), chloride (55 to 200 mg/L), and TDS (417 to 624 mg/L) between 1968 and 1976. This corresponded with the time period that large drawdowns in water levels were occurring in the Kerrville area. This well is designated as an "Emergency Only" well and does not have a pump/motor installed.

The City of Kerrville operates an ASR operation where treated surface water is injected into the Lower Trinity Aquifer to maintain aquifer pressure and provide a source for peak demand periods. This operation consists of two wells, ASR No. 1 and ASR No. 2. This strategy aides in resiliency during various circumstances, including drought conditions or other production restraints. In addition to ASR, the City's groundwater network consists of nine well sites.

Specific strategies to meet Kerrville's future water needs are addressed in Chapter 5. If additional wells are needed for increasing supply needs, the City could consider exploring new wells outside the local area of pumping influence. The City will continue to coordinate efforts with the local GCDs to establish aquifer management policies.

3.1.9.4 City of Rocksprings

The City of Rocksprings obtains its water supply from wells completed in the Edwards Limestone of the Edwards-Trinity (Plateau) Aquifer. They are currently using a well that is located on Live Oak Street. Drilled in 2007, it is estimated to produce 500 gpm. Total gallons used in 2023 was 52,081,000. The City's Sharp (artesian) Well, is currently under maintenance, and should be back in production by the end of 2024. This well was originally drilled in 1952. This rural community has little competition for groundwater and, thus, its supply is considered dependable.

3.1.9.5 City of Brackettville and Fort Clark Springs MUD

Water wells completed in the Edwards portion of the Edwards-Trinity (Plateau) Aquifer produce water used for municipal supply in these two adjacent communities. Las Moras Springs, an identified major spring, also exists at the same location of the Fort Clark Springs wells. Under existing conditions, there appears to be sufficient supply to meet futures needs. The Kinney County GCD is currently evaluating potential impacts that might result from increased future pumping within the District.

3.1.9.6 City of Camp Wood

Camp Wood located in southwestern Real County derives its water supply mostly from Old Faithful Springs, along with a completed new well in the underlying Edwards-Trinity Aquifer The spring has reportedly always flowed. However, with increasing population and the drilling of additional wells in the area, the spring may experience decreasing flow during drought periods in the future.

3.1.9.7 City of Leakey

The City of Leakey obtains its water supply from shallow water wells ranging in depth from 34 to 42 feet in the Frio River Alluvium Aquifer. The City competes for groundwater from this small Aquifer with numerous private domestic wells. Trinity Aquifer wells in the local area have proven to be less reliable and often contain poor-quality groundwater.

3.1.9.8 City of Del Rio

The City of Del Rio is supplied with water from San Felipe Springs, which issue from the Edwards portion of the Edwards-Trinity (Plateau) Aquifer. The water is collected through pumps set in the springs, treated with microfiltration and chlorine and then distributed to the City, Laughlin Air Force Base, and outlying neighborhoods.

The average discharge of San Felipe Springs since Lake Amistad was filled is about 110 c cubic feet per second (cfs) or about 80,000 ac-ft/yr. During recent droughts, the spring discharge has fallen below 50 cfs or, extrapolated over one year, about 36,000 ac-ft. Recent droughts as compared to the 1950s drought would be appropriate to use as a drought-condition gage because the filling of Amistad Lake has generally increased the spring flow after the late 1960s.

The PWPG disagrees with the modeling scenario assumptions found in GAM Report 21-012 for the Edwards-Trinity (Plateau) Aquifer, which bases the DCFs solely on simulated spring flow conditions at San Felipe Spring of 73 to 75 million gallons per day (mgd). This converts to approximately 113 to 116 cfs. The MAG of 50,000 ac-ft/yr (Table 3-1) is not reflective of the decreased spring flow due to prolonged drought conditions. For the purpose of this *Plan*, the PWPG considers the MAG value used in previous plans of 24,988 ac-ft/yr to be a more accurate representation of the groundwater availability.

Due to prolonged drought conditions, the San Felipe Springs is no longer a reliable water supply source. Currently, the City of Del Rio is exploring an alternative source of water supply. Del Rio has completed one pilot well within the Edwards-Trinity (Plateau) Aquifer, drilled to a depth of approximately 200-250 feet. The pilot well was a success, producing roughly 3,223 ac-ft/yr. The City recognizes the importance of transitioning away from the drought impacted spring flows, to a more reliable water-supply source that can sustain future growth. Therefore, the City has plans to drill a second well.

3.1.10 Agricultural Use of Groundwater

Because of the arid conditions and lack of well-developed soils over much of the Region, irrigated agricultural activities are generally limited in most of the counties. Low well yields common throughout much of the Region also limit the development of large-scale irrigation. Water quality, however, is not generally a limiting factor for irrigation in the Region. Kinney County has the greatest amount of agricultural use of water. The acreage of land irrigated by groundwater in the year 2000 in each county as reported in TWDB Report 347 is, from most to least, Kinney, 4,865 acres; Bandera, 173 acres; Val Verde, 145 acres; Kerr, 57 acres; Edwards, 40 acres; and Real, 15 acres. In addition, numerous surveyed small feed plots for game are irrigated with groundwater. The PWPG is concerned about the accuracy of the irrigation surveys and believes that there is significantly more irrigation water use than is documented. For example, the Headwaters GCD in Kerr County documents approximately 700 acres being irrigated just with groundwater.

A review of historical and current data suggests that there has been no long-term change in regional water levels or water quality because of agricultural pumping. Local water-level declines occur during the irrigation season but generally recover during the off-season. Although irrigation conservation efficiencies could be improved, currently used equipment and practices are not resulting in depletion of the aquifers. At the current rate of agricultural use, groundwater of sufficient quantity in the Edward-Trinity (Plateau), Edwards (BFZ), and Austin Chalk Aquifers should remain available for future agricultural use. However, the competition for Trinity Aquifer water between municipal and agricultural needs in Bandera and Kerr Counties is increasing. The Bandera County River Authority and Groundwater District and the Headwaters GCD are both actively involved in managing the use of groundwater in these counties.

3.1.11 Brackish Groundwater Desalination Sources

In the Plateau Region, shallow groundwater from the surface down to approximately 800 to 1,000 feet in depth contains TDS concentrations of less than 1,000 mg/L and thus meets drinking water standards. Groundwater of slightly poorer quality (1,000 to 2,999 mg/L TDS) occurs in the Trinity Aquifer in some areas within the Region. Elevated levels of calcium sulfate in higher TDS groundwater are the result of dissolution of evaporite beds in the Lower Glen Rose formation.

Brackish water is defined by the TWDB as having TDS in the range from 1,000 to 9,999 mg/L. In the Plateau Region, brackish groundwater typically occurs in three areas: (1) as isolated pockets within freshwater aquifers, (2) as isolated areas near the base of the Cretaceous System in southern portions of the Plateau Region, and (3) near the base of the Paleozoic System in northern portions of the Region.

No appreciable groundwater has ever been found below the Cretaceous System in the buried Pennsylvanian Ouachita fold belt. However, the deep, narrow Val Verde Basin developed in front of the buried Ouachita Mountain range. The Val Verde Basin extends over the Plateau Region north of the Ouachita fold belt and thins to the north. This Basin holds a vast amount of saline water at depths that range from 800 to 25,000 feet. Although brackish groundwater in the range of 1,000 to 9,999 mg/L TDS occurs only within a few hundred feet in depth of the freshwater-saline water interface, the groundwater below the brackish zone ranges up to about 180,000 mg/L TDS (average seawater is 35,000 mg/L). Thus, a vast source of saline water is available in the Region but would require desalination for use as a source of drinking water.

The TWDB Brackish Resources Aquifer Characterization System (BRACS) Program anticipates the completion of the Edwards-Trinity (Plateau) Aquifer study by Jan. 2025. More information regarding brackish groundwater as a future supply within the Region will be provided in the next round of regional water planning.

3.2 SURFACE WATER SUPPLIES

The Plateau Region straddles several different river basins, rather than generally following a single river basin or a large part of a single river basin (Figure 3-2). From west to east, these basins include the Rio Grande, Nueces, Colorado, San Antonio, and Guadalupe. The headwaters of three of these river basins (Nueces, San Antonio, and Guadalupe), as well as major tributaries of the Rio Grande and Colorado River, originate in this Region.

The availability of water from surface water sources under DOR conditions depend on two components: (1) water that is physically present (usually substantially reduced during a DOR since by definition it is the most severe) and (2) the authorized amount per existing water right adjudications. The TCEQ maintains WAMs for evaluating water rights applications to help determine if water would be available for a newly requested water right or amendment, or if an amendment might affect other water rights. The "Run 3" WAM scenario primarily used by the TCEQ for these purposes has a key assumption that all water rights in each basin are allowed to divert their full authorized amount when water is available, following appropriation in priority date order. The "Run 3" scenario also reflects the conservative assumption that no return flows (i.e., discharges) are present.

Use of the TCEQ WAMs allows for the performance of a simulation of availability and diversion for all water rights in a river basin based on naturalized flows over a specified hydrologic period in a manner that includes the key assumptions used for permitting by the State and is consistent with TWDB regional planning guidelines.

The TCEQ WAMs of the five Plateau Region river basins denoted below have been used for the purposes of the *2026 Plateau Regional Water Plan* to determine surface water source availability during a DOR. Model versions and input files for the development of this *Plan* are listed below.

Folder Name	Description	Use	Version Date	Simulation Date
colo-full	Files for Colorado River Basin Region J WAM with no modifications from TCEQ Run3.	Colorado River Basin Run-of-river minimum annual diversions.	10/1/2023	3/29/2024
gsa-full	Files for Guadalupe San Antonio River Basin Region J WAM with no modifications from TCEQ Run3.	Guadalupe San Antonio River Basin Run-of-river minimum annual diversions and firm yields for municipal diversions.	10/1/2023	4/1/2024
nueces-full	Files for Nueces River Basin Region J WAM with no modifications from TCEQ Run3.	Nueces River Basin Run-of-river minimum annual diversions and firm yields for municipal diversions.	10/1/2023	4/1/2024
riogrande-full	Files for Rio Grande River Basin Region J WAM with no modifications from TCEQ Run3.	Rio Grande River Basin Run-of-river minimum annual diversions and firm yields for municipal diversions.	10/1/2023	4/1/2024

Municipal run-of-river calculations use the unmodified TCEQ WAM Run 3 to ensure that all monthly demands are fully met. Area-capacity relations of major reservoirs have been adjusted to reflect sedimentation conditions for 2020 through 2070, consistent with the approved Hydrologic Variance Request developed and submitted by the Plateau Regional Water Planning Group. DOR source amounts by county and river basin are provided in Table 3-1. Water Source Availability (ac-ft/yr). A list of all authorized surface water rights in the Region is available in Appendix 3A.

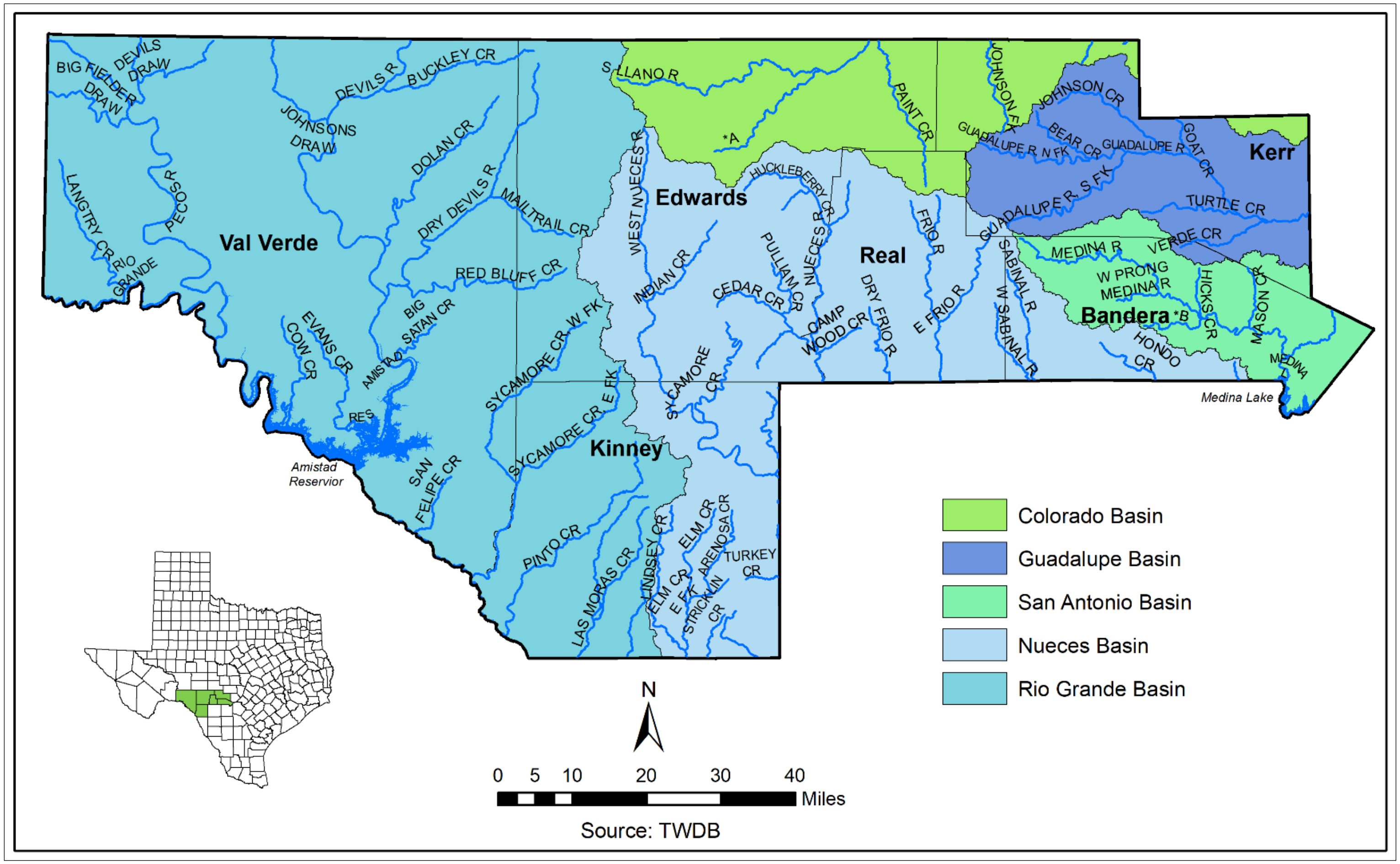

Figure 3-2. Surface Water Sources

The term "run-of-the-river" is used to distinguish water rights with diversion points directly on a watercourse from water rights with diversion points on a reservoir or backed by storage. Generally, run-of-the-river water rights, also referred to as "direct diversions," are less dependable than water rights on reservoirs because of the lack of storage. However, run-of-the-river diversions are often very convenient, especially for irrigators and small entities, because a diversion point on a watercourse can be located extremely close to the location where the water will be consumed, thereby negating the need to pipe the water over long distances.

Diversions under a DOR are extracted from results of a WAM simulation for each basin. For purposes of this *Plan*, a DOR supply for run-of-the-river diversions is categorized by use (municipal, irrigation, industrial and other) and by county. Supply amounts on river segments have always been difficult to assess due to the lack of storage to catch excess flows. In this *Plan*, the reliable supply for run-of-the-river diversions for non-municipal use is expressed as the minimum annual diversion for each category during the hydrologic period considered in the water availability models. The reliable supply for run-of-the-river diversions for municipal use is expressed as the minimum monthly diversion amount that is available in all months of the hydrologic period considered in the water availability models.

DOR supply amounts for reservoirs are on a firm-yield basis. To understand firm yield, one must understand the concept of "mass balance" - the simple but true principle of physics that mass can neither be created nor be destroyed (i.e., what goes in must come out). In practical terms as applied to a reservoir, the water going in (inflows from drainage areas of tributaries feeding the reservoir site and direct precipitation upon the reservoir itself) equals the water going out (evaporation off the lake surface plus water spilled over the dam plus any water allowed to pass through the dam to satisfy senior water rights downstream plus the demand placed on the reservoir plus other factors which may exist). The operation of a reservoir is simulated under various demands, iterating the simulation to find a demand that the reservoir can supply consistently throughout a repeat of the historical hydrologic record. Demand is termed the "firm yield" of the reservoir if for every year of the historical hydrologic record (even during a DOR) the reservoir can successfully supply the demand placed on it.

Canyon Reservoir and the Medina/Diversion system are potential water supply reservoirs for the Plateau Region's future water needs. Although neither reservoir currently serves a water need within the Region, both reservoirs could likely do so in the future. Although recreational use of streams and lakes serves an important function in the Plateau Region, its use has no impact on reservoir yields, as these uses are non-consumptive.

3.2.1 Rio Grande Basin (Including the Pecos and Devils River)

The Rio Grande, or Rio Bravo as it is known in Mexico, forms the border between the United States and Mexico. International treaties govern the ownership and distribution of the water in this river. Under the 1906 Treaty, the United States is obligated to deliver 60,000 ac-ft annually from the Rio Grande to Mexico, except in the cases of severe drought or serious accident to the irrigation system in the United States. Diversion of this allotment occurs upriver in El Paso. The 1944 Treaty addresses the waters in the international segment of the Rio Grande from Fort Quitman, Texas to the Gulf of Mexico. The United States receives one-third of the flow from six tributaries (Rio Conchos, San Diego, San Rodrigo, Escondido, Salado Rivers, and Las Vacas Arroyo), provided that the running average over a five-year period cannot be less than 350,000 ac-ft/yr.

While the International Boundary and Water Commission is responsible for implementing the allocation of water on the U.S. side, the Watermaster office of TCEQ administers the allocation of Texas' share of the international waters. The two reservoirs located in the middle of the lower Rio Grande, the Amistad and Falcon, store the water regulated by the Watermaster. The Watermaster oversees Texas' share of water in the Rio Grande and its Texas tributaries from Fort Quitman to Amistad Dam, excluding drainage basins of the Pecos River and Devils River.

The Pecos River forms a portion of the boundary between Terrell County in the Far West Texas Region and Crockett County in Region F before reaching Langtry in Val Verde County in the Plateau Region. The Devils River originates in Sutton County and proceeds generally southward through Val Verde County before reaching Amistad International Reservoir. There are no surface-water rights on the Pecos and Devils Rivers within the Plateau Region.

Flow of the Pecos River within the Plateau Region is inconsistent, with livestock and wildlife watering apparently being the only use made of whatever water that may remain in the River. Independence Creek, a large spring-fed creek in northern Terrell County west of Val Verde County, is the most important of the few remaining freshwater tributaries to the lower Pecos River. Independence Creek's contribution increases the Pecos River water volume by 42 percent at the confluence and reduces the total suspended solids by 50 percent, thus improving both water quantity and quality (Nature Conservancy of Texas descriptive flier).

Flows of the Devils River are gaged at the Spafford Crossing near Comstock in Val Verde County. This gage (USGS 08449400) began recording in 1978 and was discontinued in 1985. Therefore, it does not record flows for the 1950s. However, from 1978 through 1985 the flows are consistently between approximately 100 and 300 cfs, with rare spikes ranging from 4,000 cfs up to 50,000 cfs. These spikes result from unusually intense but short rainfall events. In absence of data for the 1950s-drought period and considering the generally low and undependable flows within the Devils River, a realistic estimate of the DOR amount of supply from the Devils River within the Plateau Region is zero.

3.2.2 Amistad International Reservoir on the Rio Grande

The Amistad International Reservoir is located on the border between the United States and Mexico near the City of Del Rio and was constructed jointly by the two nations. It was completed in 1968 with a maximum capacity of 5,250,000 ac-ft, 3,505,000 ac-ft of which are used for water conservation. The water is distributed among downstream users of Mexico and the United States. Amistad is not a source of supply for the Plateau Region, as the City of Del Rio and downstream irrigators in Val Verde County obtain their supply primarily from San Felipe Springs and Creek. Thus, the constraints on Amistad Reservoir as a source of water supply for the Plateau Region are the existing water rights held by water rights holders and enforced by the Rio Grande Watermaster.

Goodenough Spring is inundated by Lake Amistad and was at one time considered the third largest spring in Texas. The spring, which discharges from the Edwards-Trinity (Plateau) Aquifer, still provides a significant flow contribution to the Rio Grande.

3.2.3 Nueces River Basin

The upper Nueces River Basin lies in Edwards, Real, Bandera, and Kinney Counties, with the main stem Nueces forming a portion of the border between Real County and Edwards County. Headwater tributaries of the Nueces River located in the Plateau Region include the Sabinal River and Hondo Creek in Bandera County, the West Nueces River in Edwards and Kinney Counties, and the Frio, East Frio, and Dry Frio Rivers in Real County. Although undocumented, in some places there appears to be an amount of underflow occurring through gravel beds that line long stretches of the river bottom.

Total authorized diversions by water rights on the Nueces River within the Plateau Region are 11,419 ac-ft/yr. Most of this amount (10,116 ac-ft/yr or 88 percent) is for irrigation use. Diversions for municipal use total 1,259 ac-ft/yr. The City of Camp Wood holds the largest municipal right for 1,000 ac-ft/yr. Small water rights for other uses have a total authorized diversion of 44 ac-ft/yr.

The TCEQ Water Availability Model for the Nueces River Basin was used to evaluate surface water supplies. The model includes data through the year 1996, and addresses the DOR of the 1950s.

3.2.4 Colorado River Basin

The headwaters of the South Llano River, a tributary of the Colorado River, lie in Edwards County. There are three water rights on the South Llano River and Paint Creek within the Plateau Region for irrigation use. The combined authorized amount of these rights is 180 ac-ft/yr.

The TCEQ Colorado River Basin WAM was used to evaluate the supply for these rights. This model covers the period 2016. Hydrologic data for these streams suggests that the DOR occurred in 2011. The minimum annual diversion for the three rights is 32 acre-ft/yr.

3.2.5 San Antonio River Basin

The headwaters of the San Antonio River lie in Bandera County. Most water right authorizations from the San Antonio Basin are run-of-the-river diversions for irrigation use. Run-of-the-river diversions exclude authorizations on Medina Lake. Eight authorized water rights on the Medina River main stem total 236 ac-ft/yr. Of these eight water-right holders on the River, six use the water for irrigation. The sum of these six irrigation rights totals 227 ac-ft/yr. Of the remaining two water-right holders, one is for 9 ac-ft of water per year used by an individual for municipal purposes, and the other is for a non-consumptive recreation reservoir owned by the City of Bandera. This recreation-only reservoir is for non-consumptive use only.

Since the Guadalupe-San Antonio WAM covers the period 1934-1989, it is appropriate to consider if the drought of 1996 exceeded the severity of the drought of the mid-1950s. USGS gage 08178880 on the Medina River at Bandera just downstream of State Highway 173 gives a lowest annual streamflow amount at 33.7 cfs (approximately 24,600 ac-ft/yr) in 1996. However, this gage did not begin recording until 1982, and therefore records from the 1950s drought are missing and cannot be compared directly to the low flows of 1996. Data for the 1950s at the Bandera gage as extracted from the Guadalupe-San Antonio River Basin WAM indicates an annual naturalized flow of 2,662 ac-ft in 1956. Regulated flows would be even lower once upstream diversions and impoundments are accounted for. Therefore, based on estimates of the Guadalupe-San Antonio Basins WAM, the drought of the 1950s represents the DOR conditions for the San Antonio Basin in the Plateau Region.

3.2.6 Medina Lake on the Medina River

Medina Lake was constructed in 1911 to provide irrigation water for farmers to the southwest of San Antonio. Although commonly referred to as Medina Lake, the lake is actually a system consisting of Medina Lake and Diversion Lake. Impounded in 1913, Diversion Lake is approximately four miles downstream of Medina Lake.

Diversions from the dual-lake system are authorized only from Diversion Lake, as per the water right held by Bexar-Medina-Atascosa Water Control and Improvement District No. 1 (BMAWCID No. 1). BMAWCID No. 1's Adjudication Certificate No. 19-2130C authorizes the District to divert up to 65,830 ac-ft/yr of water for irrigation, municipal and industrial use, up to 750 ac-ft/yr specifically for domestic and livestock purposes, and up to 170 ac-ft/yr specifically for municipal use.

BMAWCID No. 1 has signed contracts to supply several irrigators and a development corporation with water. In January 2000, BMAWCID No. 1 signed a contract with Bexar Metropolitan Water Authority indicating that BMAWCID No. 1 will sell 20,000 ac-ft/yr to the Authority for municipal use.

Bandera County currently has a Water Supply Agreement with BMAWCID No. 1 for purchase of up to 5,000 ac-ft/yr; however, this agreement is not currently associated with the infrastructure necessary to carry out the purchase and subsequent distribution of the water.

Loss of impounded water from Medina Lake to the Trinity Aquifer and Diversion Lake to the Edwards Aquifer reduces the firm yield of the system. This loss has long been known to be substantial. Quantification of water recharging the aquifers has been elusive, as different estimates of recharge have resulted in different firm-yield estimates for the system. In 1957, a Bureau of Reclamation study estimated the firm annual yield of the Medina Lake/Diversion Lake system to be 27,500 ac-ft/yr if the lake system were operated under an agricultural (irrigation) demand only scenario, but it estimated 29,700 ac-ft/yr as the firm yield for municipal and industrial demand. Due to effects of seepage around the dam and of recharge to the underlying aquifers, Espey Huston estimated a firm yield of zero for Medina Lake in 1994, based on the relationship they found between the Lake stage and recharge. HDR Engineering modified the Espey Huston stage-recharge curves for its Trans-Texas report and cited 8,770 ac-ft/yr as the firm yield. According to previous communications, HDR assumed diversions would be from Medina Lake rather than from Diversion Lake and that all irrigation use would be curtailed. This assumption does not comply with existing conditions as regards to water right authorizations.

The latest USGS report, "Assessment of Hydrogeology, Hydrologic Budget, and Water Chemistry of the Medina Lake Area, Medina and Bandera Counties, Texas," maintains that earlier methods of estimating recharge (Lowry, Espey Huston curves as modified by HDR for the Trans-Texas report) overestimate recharge. Overestimation of recharge would result in an underestimation of firm yield; however, the USGS report did not include a firm-yield estimate for the reservoir system.

The TCEQ Guadalupe-San Antonio River Basins WAM incorporates the HDR Trans-Texas method of estimating recharge and probably provides the best overall data (water rights, inflows determined by water rights) available at this time. The model was thus used to determine a firm yield of the Medina/Diversion system of zero ac-ft/yr.

3.2.7 Guadalupe River Basin

Within the Plateau Region, the Guadalupe River Basin occurs almost exclusively within Kerr County. The Basin drains approximately 510 square miles at Kerrville, and approximately 839 square miles at Comfort near the eastern county line. The River originates almost entirely within western Kerr County as three branches (Johnson Creek, North Fork, and South Fork) merge west of Kerrville to form the main river course. A study report titled Spring Flow Contribution to the Headwater of the Guadalupe River in Western Kerr County (2005) was prepared for the PWPG and is available on the Planning Group's website.

The total amount of authorized water rights for the Guadalupe River within the Plateau Region is 21,020 ac-ft/yr. Municipal use accounts for 8,076 ac-ft/yr. Holders of these water rights include the City of Kerrville, the UGRA, and independent persons.

The City of Kerrville and the UGRA own the largest municipal water rights. Certificate of Adjudication 1996, 5394-B, 2026 and Permit 3505 are held by Kerrville. UGRA holds Permit 5394-D. Authorized diversions from the Guadalupe River associated with these water rights are taken from an 840-acre on-channel reservoir located in the City of Kerrville and are pumped from the reservoir to Kerrville's water treatment plant. A summary of the pertinent information for their water rights is shown in Table 3-5.

Texas Parks and Wildlife Department owns a continuous flow-through water right for 5,780 ac-ft/yr used for the Heart of the Hills Fisheries Science Center, consumptive use is approximately 400 ac-ft/yr. Industrial use permits are authorized for 17 ac-ft/yr and irrigation rights for 6,904 ac-ft/yr. The remaining water-rights holders use their water for mining, hydroelectric power, and recreation. One individual holds a water right (35,125 ac-ft/yr) for hydroelectric use; however, this right has not been exercised. Kerr County holds the rights for three non-consumptive recreation-use reservoirs in and near Kerrville.

Table 3-5. Municipal Water Rights for Kerrville and UGRA

<table>
<tr><th>Water Rights Permit</th><th>Authorized Diversion (acre-ft/yr.)</th><th>Permit Holder</th><th>Priority Data</th><th>Storage (ac-ft)</th><th>Restrictions</th></tr>
<tr><td>1996
(amended 4/10/98)</td><td>225 (Mun.)</td><td>Kerrville</td><td>4/4/1914</td><td></td><td></td></tr>
<tr><td>3505</td><td>3,603</td><td>Kerrville</td><td>5/23/1977</td><td>840</td><td>Max diversion rate = 9.7 cfs
Divert only when reservoir is above 1,608 ft msl</td></tr>
<tr><td rowspan="2">5394-B & 5394-D
(amended 4/10/98)</td><td>2,169</td><td>Kerrville
(Kerrville Municipal use)</td><td rowspan="2">1/6/1992</td><td rowspan="2">Utilizes the storage authorized for Permit 3505</td><td rowspan="2">Max combined diversion rate for water rights #3505 and #5394 = 15.5 cfs.
Minimum instream flow requirements vary from 30 to 50 cfs during year.</td></tr>
<tr><td>2,000</td><td>UGRA
(County Municipal use)</td></tr>
</table>

Note: Permit 2026 (priority 1961) 54 ac/ft municipal use.

During winter months when there is surplus surface water supply, a portion of the treated water is injected into the Lower Trinity Aquifer for subsequent use during the typically dry summer months. This ASR program has been in full operation since 1998.

Both the City of Kerrville and the UGRA have within their authorizations (Permits Nos. 5394B and 5394D respectively) a Special Condition addressing the seasonal distribution of allowed diversions. The Special Condition stipulates that during the months of October through May, the permittees may divert only when the flow of the Guadalupe River exceeds 50 cfs, and during the months of June through September, the permittees are authorized to divert only when the flow of the Guadalupe River exceeds 30 cfs. Another Special Condition common to both permittees is that, when inflows to Canyon Reservoir are less than 50 cfs, each permittee is to restrict diversions to allow a flow of at least 50 cfs to pass through. Yet another Special Condition imposed on both permittees is that diversions may be made only when the level of Nimitz Lake (the UGRA Lake renamed in 2011) is above 1,608 feet above mean sea level.

Pursuant to a Memorandum of Understanding (MOU) between the Guadalupe-Blanco River Authority (GBRA) and the Commissioner’s Court of Kerr County, the South-Central Texas Water Planning Group (Region L) recognizes a potential commitment of approximately 2,000 ac-ft/yr from the firm yield of Canyon Reservoir for the calendar years 2021 through 2050. GBRA’s hydrology studies indicate that a commitment of about 2,000 ac-ft/yr would be necessary to allow permits for 6,000 ac-ft/yr to be issued by TCEQ for diversions in Kerr County.

Data from the Corps of Engineers show a computed inflow into Lake Canyon of 132,900 ac-ft/yr in 1996. The Guadalupe-San Antonio WAM estimates naturalized flows to be 27,800 ac-ft in 1956. The USGS gage 08167000 on the Guadalupe River at Comfort gives a lowest annual streamflow amount of 14.5 cfs (approximately 10,585 ac-ft/yr) occurring in 1956. This gage has been recording since 1939. Interestingly, statistics for the gage include the fact that, for water years 1939 through 1997, the mean annual runoff was 157,800 ac-ft or approximately 216 cfs, and that 90 percent of these flows exceeded 25 cfs. This puts the 1956 occurrence of 14.5 cfs within the 0 to 10 percent non-exceedance category. In calendar year 1996, the annual mean was 151 cfs and the median was 85 cfs. The mean and median for 1997 exceeded the 1996 values. These facts seem to substantiate that the drought-of-record for Kerr County occurred in 1956, not in 1996, as consistent with most other areas of the State.

3.2.8 San Felipe Springs

The City of Del Rio has a water right authorizing it to divert 11,416 ac-ft/yr from San Felipe Springs for municipal use. San Felipe Manufacturing and Irrigation Company has a water right authorizing it to divert 4,962 ac-ft/yr for irrigation use and 50 ac-ft/yr for industrial use. No data exists for flows during the drought of the 1950s. The only available records are from USGS gage 08452800 maintained by the IBWC at San Felipe Springs that covers the period of February 1961 to present. The minimum annual amount during this time period was 36,580 ac-ft/yr (occurring in 1963).

3.2.9 Old Faithful Springs

Issuing from the upper Glen Rose Limestone portion of the Edwards-Trinity (Plateau) Aquifer, Old Faithful Springs is the primary water supply for the City of Camp Wood. The spring has been a dependable source and was reported to have continuously flowed during the 1950s drought. There is current concern that the increase in the number of wells being drilled in the area may lower the local water table and thus negatively impact spring flow. The spring is privately owned and may not be available for City use after the current contract expires.

3.2.10 Surface Water Rights

The right to use surface water from streams and lakes is permitted through the State of Texas. A list of all authorized surface water rights in the Region is available in Appendix 3A.

Major downstream water rights include those in Region L supplied by the GBRA out of Canyon Lake and by the Bexar-Medina-Atascosa WCID No. 1 out of the Medina/Diversion system. The firm yields of Canyon and Medina limit the amount of water available for appropriation in both the Plateau Region and Region L. Major downstream water rights in Region M (i.e., cities and irrigators on the Rio Grande downstream from Amistad Reservoir) do not limit the amount of water available for appropriation in the Plateau Region because currently the Plateau Region does not depend on the Falcon-Amistad system. TCEQ’s Lower Rio Grande Watermaster allocates water rights on the Rio Grande according to the supply in the Amistad Reservoir and in accordance with the 1944 International Treaty with Mexico.

3.3 GROUNDWATER/SURFACE WATER RELATIONSHIP

In the natural environment, water is constantly in transition between the land surface and underground aquifers. Under certain conditions, stream losses percolate downward to underlying aquifers as recharge; while in other cases, aquifers give up water to the land surface in the form of springs and seeps.

Most of the Plateau Region occurs at higher elevations that constitute the headwaters of the numerous streams and tributaries that frequent this Region. At these elevations, significant quantities of water exit the aquifer systems through springs and form the base flow of the surface streams. Downstream, only a portion of that water may render the underground system. For this reason, these streams are generally gaining throughout much of their extent within the Plateau Region. Spring flows are also environmentally important in that they are the primary source of water for wildlife in the area. These discharges from springs are thus the primary source of continuous flow to the rivers downstream and, therefore, their protection is warranted. Springs are so common to this headwater region that a popular beverage slogan touted “From the Land of 1,100 Springs.”

Some of the largest springs in the Region, such as San Felipe Springs (Val Verde County) and Las Moras Springs (Kinney County), issue from the Edwards limestone. However, numerous other springs issue from either the Edwards or Glen Rose Limestones. Many of the springs, such as Fessenden Spring (Kerr County), issue near the contact between the Edwards and the upper Glen Rose Limestones. Smaller springs are more prevalent where they issue from the Glen Rose, particularly in Bandera and Kerr Counties.

Most springs located in the headwaters of rivers that traverse the eastern part of the Region issue from the contact between the Edwards limestone and underlying upper Glen Rose limestone. Most well production in this area is from deeper aquifers and, therefore, little impact to spring flow from the pumping is anticipated. However, as new development expands to the west, care should be given to potential water level declines that could diminish spring flow and base flow to the rivers.

Springs located in the western part of the Region issue primarily from the Edwards Limestone. Because of limited pumping of groundwater from wells in the Del Rio area, San Felipe Springs has not had to compete for source water. A significant increase in groundwater pumpage immediate up dip and to the east of the springs may lower the water table sufficiently to affect flow from the springs. Because much of the recharge areas for the contributing zones of these western springs occur in remote areas, very little information is available concerning the relationship between the springs and the underlying aquifers.

Gain/loss studies are needed to identify stream segments that are critical to aquifer recharge and spring discharge. The studies can be used to identify where recharge structures would be most efficient and where most river base-flow gain occurs. Specific candidate areas occur over the plateau area that is underlain by Edwards Limestone, especially in the upper tributaries of all the rivers. Gain/loss studies of tributaries in the vicinity of Del Rio would be beneficial in understanding the recharge areas that contribute to San Felipe Springs.

Two supplemental study reports were prepared for the Plateau Region Water Plan that address springs. The first report. “Springs of Kinney and Val Verde Counties, 2005” considers the location and geohydrology of springs in Kinney and Val Verde Counties, and the second report, “Spring Flow Contribution to the Headwaters of the Guadalupe River in Western Kerr County, Texas, 2005” relates spring flow in western Kerr County to base flow in the three branches of the upper Guadalupe River.

3.4 WATER REUSE

While recycling is a term generally applied to aluminum cans, glass bottles, and newspapers, water can be recycled as well. Water recycling is reusing treated wastewater for beneficial purposes such as agricultural and landscape irrigation, industrial processes, toilet flushing, and replenishing a groundwater aquifer (referred to as groundwater recharge or ASR). Water is sometimes recycled and reused onsite; for example, when an industrial facility recycles water used for cooling processes. A common type of recycled water is water that has been reclaimed from municipal wastewater, or sewage. The term "water recycling" is generally used synonymously with water reclamation and water reuse.

Kerrville treats its wastewater to TCEQ type 1 level. The treated wastewater is pumped through a dedicated pipeline for reuse as irrigation water for the Scott Schreiner Municipal Golf Course, the Hill Country Youth Soccer Fields, Kerrville Sports Complex, Schreiner University, River Hills Golf Course, Tivy High School Sports Fields, Kerr County Animal Shelter, and the golf course at Comanche Trace Ranch & Golf Club. Additional treated water is sold by the truckload for construction projects. The remaining wastewater is released into Third Creek, which flows into Flatrock Lake on the Guadalupe River. That water is then available for use downstream of Kerrville. Additionally, the City has reserved approximately 0.5 MGD of treated effluent above its current reuse contract obligations for future potable or non-potable reuse. To further reduce potable water demand and dependency on groundwater and surface water supplies, the City expanded its non-potable reuse delivery capacity by constructing a 95 million gallon (292 ac-ft.) off-channel storage pond adjacent to the wastewater treatment plant. The Cities of Del Rio and Bandera also have wastewater treatment capacities with the potential for reuse applications.

Existing direct reuse supply availability as shown in Table 3-1 is listed as:

- Kerr County – Guadalupe Basin – 5,000 ac-ft/year.
  (City of Kerrville permitted volume)
- Bandera County – San Antonio Basin – 310 ac-ft/year.
  (City of Bandera average discharge)

Future direct reuse supply availability not shown in Table 3-1:

- Val Verde County – Rio Grande basin – 3,100 ac-ft/year.
  (Del Rio Utilities Commission permitted volume)

3.5 LOCAL SUPPLY

"Local Supplies" are limited, unnamed individual surface water supplies that, separately, are available only to particular non-municipal WUGs. These supplies are generally contained within "stock tanks" that catch precipitation runoff and are used primarily for livestock watering, but at times may be available for other local needs such as mining. For planning purposes, the volume of runoff water in these catchment basins is considered to be significantly reduced during DOR conditions and does not include any groundwater that might be pumped into them.

For the purposes of the *2026 Plateau Region Water Plan*, the historical water-use estimates (2011-2021) for irrigation, livestock, manufacturing, mining and steam-electric, generated directly from the TWDB's Water Use Database was considered in determining existing local surface water supply volumes. These reports reflect the most current and accurate data made available to the State agency. New to this *Plan,* is the "Livestock Local Surface Water Supply" category found on Table 3-2, of which provides an additional 733 ac-ft per decade, of existing surface water supply to the Region, throughout the planning horizon.

APPENDIX 3A
AUTHORIZED SURFACE WATER RIGHTS

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APPENDIX 3A. Authorized Surface Water Rights as Extracted from TCEQ's Active Water Rights Master File

Water Right Number	Type	County	River Order Permit	Name	Stream	Use	Amount in Ac-Ft/Yr	Acreage	Res Cap in Ac-Ft	Remarks
2027-000	6	Bandera	7720000000	ROBERT L PARKER SR ET AL	VERDE CRK	IRRG	8	3		
2028-000	6	Bandera	7750000000	HOWARD E BUTT	PALMER CRK	OTHER			30	
2103-000	6	Bandera	5903000000	O S PETTY	HONEY CRK	IRRG	96	38		
2104-000	6	Bandera	5902000000	CLARENCE E LAUTZENHEISER ET UX	N PRONG MEDINA RIVER	IRRG	20.24	23.85		AMEND 9/29/88, 8/22/89
2105-000	6	Bandera	5901500000	STEVEN L PRICHARD TRUSTEE	MICKLE	IRRG	5.44	8.16	5	
2105-000	6	Bandera	5901500000	NEAL INCORPORATED	MICKLE	IRRG	7.32	10.99	5	
2106-000	6	Bandera	5901450000	BREWINGTON LAKE RANCH ASSN	BREWINGTON CRK	REC	190		190	
2107-000	6	Bandera	5901100000	JOEL HELD, TRUSTEE/JJJ RANCH	N PRONG MEDINA RIVER	IRRG	19	25		OUT OF A 1666.5 ACRE TRACT
2108-000	6	Bandera	5900100000	BEN & KAY MAYBERRY FAM PART	ROCKY CRK	IRRG	19.82	14.41		ALSO KERR CO
2108-000	6	Bandera	5900100000	WALTER A WILLOUGHBY	ROCKY CRK	IRRG	24.18	17.59		ALSO KERR CO
2109-000	6	Bandera	5897200000	NEVIN MARR	N PRONG MEDINA RIVER	IRRG	2	10		AMEND 1-21-83 INCREASE ACRES
2110-000	6	Bandera	5897000000	DONALD F & MARTHA M MEAD	N PRONG MEDINA RIVER	IRRG	21	12		
2111-000	6	Bandera	5896000000	TEXAS PETROLEUM CO. TR EST	COLLINS CRK	IRRG	4	2	16	
2112-000	6	Bandera	5894500000	MRS MARY WINKENHOWER	ELAM CRK	IRRG	27	27		JOINTLY OWNS 27 AF TO IRR 27 ACRES
2113-000	6	Bandera	5894000000	SUSAN CRAWFORD TRACY	W PRONG MEDINA RIVER	IRRG	35	45		OUT OF A 156 ACRE TRACT
2114-000	6	Bandera	5892000000	PHIL A GROTHUES ET UX	UNNAMED TRIB	IRRG	5.705	20.715		
2114-000	6	Bandera	5892000000	INMANN T DABNEY JR ET UX	UNNAMED TRIB	IRRG	6.542	23.756		
2114-000	6	Bandera	5892000000	RICHARD E WILSON	UNNAMED TRIB	IRRG	3.753	13.629		
2115-000	6	Bandera	5891500000	DAVID R SCHMIDT MD ET AL	BAUERLEIN CRK	IRRG	15	16		
2116-000	6	Bandera	5891000000	PAUL LAVON GARRISON	W PRONG MEDINA RIVER	IRRG	36	36		
2116-000	6	Bandera	5891000000	GEORGE C. YAX	W PRONG MEDINA RIVER	IRRG	15	15	162	
2117-000	6	Bandera	5889000000	G. MILTON JOHNSON, ET UX	MEDINA RIVER	IRRG	7	7		OUT OF A 175.5 ACRE TRACT
2118-000	6	Bandera	5888870000	DAVID J BRASK	UNNAMED TRIB	IRRG	16	16		
2119-000	6	Bandera	5888090000	RAYMOND HICKS	MEDINA RIVER	IRRG	3	8		
2120-000	6	Bandera	5888051000	BANDERA ELECTRIC COOP INC	MEDINA RIVER	IRRG	2	4		7/8/82 ADD DIV PT
2121-000	6	Bandera	5888087000	ANN DARTHULA MAULDIN	INDIAN CRK	IRRG	31.03	8.27		
2121-000	6	Bandera	5888087000	TOLBERT S WILKINSON ET UX	INDIAN CRK	IRRG	69.47	18.53		AMEND 7/30/90
2121-000	6	Bandera	5888087000	JOHN W DINSE ET UX	INDIAN CRK	IRRG	49.5	13.2		

APPENDIX 3A. (Continued) Authorized Surface Water Rights as Extracted from TCEQ's Active Water Rights Master File

Water Right Number	Type	County	River Order Permit	Name	Stream	Use	Amount in Ac-Ft/Yr	Acreage	Res Cap in Ac-Ft	Remarks
2122-000	6	Bandera	5887330000	DON HICKS	MEDINA RIVER	MUNI	9			
2123-000	6	Bandera	5887150000	DON F TOBIN	MEDINA RIVER	IRRG	152	61		OUT OF A 452 ACRE TRACT
2124-000	6	Bandera	5887130000	EVANGELINE RATCLIFFE WILSON	SAN JULIAN CRK	IRRG	3	5		
2125-000	6	Bandera	5887129000	PETER K SHAVER ET UX	SAN JULIAN CRK	IRRG	18	30		
2126-000	6	Bandera	5887105000	STANLEY D ROSENBERG ET UX	MEDINA RIVER	IRRG	47	36		
2127-000	6	Bandera	5887100000	JERRY B PARKER ET AL	MEDINA RIVER	IRRG	16	8		
2128-000	6	Bandera	5887050000	JOE H BERRY	SADDLE CRK	IRRG	14	12	3	
2129-000	6	Bandera	5887000000	JOE H BERRY	PRIVILEGE CRK	IRRG	40	33	110	
2135-000	6	Bandera	5660000000	KITTIE NELSON FERGUSON	SAN GERONIMO CRK	IRRG	5	5	28	
3176-000	6	Bandera	2851020000	TEXAS PARKS & WILDLIFE DEPT	CAN CRK	MUNI	7			
3176-000	6	Bandera	2851020000	TEXAS PARKS & WILDLIFE DEPT	CAN CRK	IRRG		3		
3177-000	6	Bandera	2850500000	BETTY F LEIGHTON	SABINAL RIVER	MUNI	4			
3178-000	6	Bandera	2850000000	KING & JEWEL FISHER	SABINAL RIVER	IRRG	40	56	2	AMENDED 6/21/96
3179-000	6	Bandera	2825000000	JOHN K HARRELL	SABINAL RIVER	IRRG	28.196	95.257		
3179-000	6	Bandera	2825000000	BARBARA JEAN GROTH ET VIR	SABINAL RIVER	IRRG	8.804	29.743		
3184-000	6	Bandera	2675000000	ENRIQUE S PALOMO ET UX	SPRING CRK	IRRG	10	5	42	
3185-000	6	Bandera	2651700000	W H THOMPSON JR	WILLIAMS CRK	IRRG	15	5	2	CURRENT OWNER UNKNOWN, 5/98
3186-000	6	Bandera	2651500000	DOROTHY BAIRD MATTIZA	WILLIAMS CRK	IRRG	128	88	73	
3187-000	6	Bandera	2651000000	CHESTER N POSEY ET UX	WILLIAMS CRK	IRRG	23	21	15	
3188-000	6	Bandera	2650000000	W J SCHMIDT	HONDO CRK	IRRG	24	47	16	
3693-000	1	Bandera	5887260000	GERALD H PERSYN	UNNAMED TRIB BANDERA CRK	REC			11	
3824-000	1	Bandera	5887295000	CITY OF BANDERA	MEDINA RIVER	REC			22	
3825-000	1	Bandera	7718000000	ROBERT L PARKER SR ET AL	VERDE CRK	REC			277	
3853-000	1	Bandera	5888230000	ROCK CLIFF RESERVOIR LAND ASSN	SPIRES CRK	REC			925.4	AMENDED 2/17/98: IMPOUNDMENT AND EXP
3909-000	1	Bandera	5888150000	MAUDEEN M MARKS	MONTAGUE HOLLOW	REC			500	DOMESTIC, LIVESTOCK & REC
3944-000	1	Bandera	5887120000	CONOCO INCORPORATED	UNNAMED TRIB MEDINA RIVER	REC			180	2 DAMS
3949-000	1	Bandera	5886550000	CASTLE LAND & LIVESTOCK CO INC	BEAR CRK	REC	33		33	DOM & LIVESTOCK - SC
4026-000	1	Bandera	5887125000	HILL COUNTRY MANAGEMENT CORP	SAN JULIAN	REC			3	ALSO DOM & LIVESTOCK

APPENDIX 3A. (Continued) Authorized Surface Water Rights as Extracted from TCEQ's Active Water Rights Master File

Water Right Number	Type	County	River Order Permit	Name	Stream	Use	Amount in Ac-Ft/Yr	Acreage	Res Cap in Ac-Ft	Remarks
5097-000	1	Bandera	5890300000	DON CODY ET UX	W PRONG MEDINA RIVER	IRRG	120	72		EXP 2/2/2016 BY CONTRACT 1610;AMEND 9/94
5186-000	1	Bandera	2824000000	HILL COUNTRY SPRING WATER TX	SPRING	MUNI	161			BOTTLED WATER, .049 RES
5204-000	1	Bandera	2840000000	ROGER E. CANTER ET UX	SABINAL RIVER	IRRG	60	20		
5305-000	1	Bandera	2621000000	UTOPIA SPRING WATER INC	W SECO CRK	MUNI	72			
5339-000	1	Bandera	5888089000	YMCA/GREATER HOUSTON AREA	INDIAN CRK	REC			30	
5342-000	1	Bandera	5890200000	RENE H GRACIDA	W PRONG MEDIA	REC			7	
5475-000	1	Bandera	2850600000	GALLERIA HOLDING, LTD	JERNIGAN CRK	IRRG	26	18	63	2 RESERVOIRS
5575-000	1	Bandera	2850900000	ALBERT R GAGE ET UX	MARLER CRK	IRRG	12	6		SC: FLOW RESTRICTIONS
13202-000	1	Bandera		FLYING "L" GUEST RANCH, LTD.		IRRG	383			Recreation
13631-000	1	Bandera		RR 417, LLC		IRRG	40			Recreation
1527-000	6	Edwards	1750010000	ADDISON LEE PFLUGER	HUFFMAN SPRING	IRRG	32	20	1	
1528-000	6	Edwards	1735000000	RUTH MCLEAN BOWERS	PAINT CREEK	IRRG	60	54	58	CO 134, 2 RES
2451-000	6	Edwards	1750000000	ADDISON LEE PFLUGER ET AL	S LLANO RIVER	IRRG	88	74	7	AMEND 5/9/83
3017-000	6	Edwards	9520000000	RAY H EUBANK	RUTH DRAW	IRRG	50	50		AMEND 7/3/84
3023-000	6	Edwards	9195000000	DONALD P TARPEY	NUECES RIVER	IRRG	108	27		
3024-000	6	Edwards	9170000000	DOUGLAS B & MARGARET MARSHALL	NUECES RIVER	IRRG	65	43		
3038-000	6	Edwards	8900000000	ROYCE I REID ESTATE	PULLIAM CRK	IRRG	48	20		
3039-000	6	Edwards	8800000000	OLGA H. CLOUDT, ET AL	PULLIAM CRK	IRRG	75	50	8	
3039-000	6	Edwards	8800000000	OLGA H. CLOUDT, ET AL	PULLIAM CRK	IRRG	30	20		
3040-000	6	Edwards	8790000000	J R WILLIAMS ET AL	PULLIAM CRK	IRRG	34	17		
3041-000	6	Edwards	8780000000	JOSEPH C WILLIAMS	PULLIAM CRK	IRRG	60	44		1/2 INTEREST IN 60 AF FOR IRR OF 44 AC
3042-000	6	Edwards	8779000000	J R WILLIAMS ET AL	PULLIAM CRK	IRRG	22	13		
3043-000	6	Edwards	8760000000	JOY JERNIGAN OWENS	PULLIAM CRK	IRRG	32	16		
3044-000	6	Edwards	8700010000	SUSAN PETTY ARNIM ET AL	CEDAR CRK	IRRG	6	12		
3044-000	6	Edwards	8700010000	SUSAN PETTY ARNIM ET AL	CEDAR CRK	IRRG	20			
3044-000	6	Edwards	8700010000	SUSAN PETTY ARNIM ET AL	CEDAR CRK	IRRG	4	20		
3046-000	6	Edwards	8460500000	NORMA JEAN EASLEY	PULLIAM CRK	IRRG	30	59		
3047-000	6	Edwards	8400000000	BRUCE I HENDRICKSON ET UX	CLEAR CRK	IRRG	6	6	11	

APPENDIX 3A. (Continued) Authorized Surface Water Rights as Extracted from TCEQ's Active Water Rights Master File

Water Right Number	Type	County	River Order Permit	Name	Stream	Use	Amount in Ac-Ft/Yr	Acreage	Res Cap in Ac-Ft	Remarks
3048-000	6	Edwards	8340000000	L A MALACHEK ET AL	PULLIAM CRK	IRRG	27	14		
3049-000	6	Edwards	7630010000	EDWARDS CO INVEST. PARTNER	PULLIAM CRK	IRRG	250	400		
3049-000	6	Edwards	7630010000	BRUCE I HENDRICKSON ET UX	PULLIAM CRK	IRRG	350	150		
3070-000	6	Edwards	7041600000	E B CARRUTH, JR, TRUST	W NUECES RIVER	IRRG	200	184		
3070-000	6	Edwards	7041600000	E B CARRUTH, JR, TRUST	W NUECES RIVER	REC			19	
3957-000	1	Edwards	8550000000	S A WILLIAMS	CEDAR CRK	IRRG	40	40		AMEND 1/13/87
4006-000	1	Edwards	8790100000	BAY-HOUSTON TOWING CO	PULLIAM	IRRG	150	75		
4278-000	1	Edwards	8920000000	BERRYMAN INVESTMENTS INC	PULLIAM CRK	IRRG	4.34	7.38		OWNS DAM & RESERVOIR
4278-000	1	Edwards	8920000000	SAM P WORDEN ET UX	PULLIAM CRK	IRRG	5.66	9.62		
1930-000	6	Kerr	9570000000	HERSHEL REID ET UX	FLAT ROCK CRK	IRRG	69	66	35	
1932-000	6	Kerr	9560000000	PRESBYTERIAN MO-RANCH ASSEMBLY	N FRK GUADALUPE RIVER	MUNI	60			AMEND 6/7/94
1932-000	6	Kerr	9560000000	PRESBYTERIAN MO-RANCH ASSEMBLY	N FRK GUADALUPE RIVER	IRRG	14	7		AMEND 6/7/94
1932-000	6	Kerr	9560000000	PRESBYTERIAN MO-RANCH ASSEMBLY	N FRK GUADALUPE RIVER	REC	25		20	AMEND 6/7/94
1934-000	6	Kerr	9527000000	CHARLES K HICKEY JR ET AL	DRY CRK	IRRG	0.45	0.68		
1934-000	6	Kerr	9527000000	KATHY JAN FREEMAN	DRY CRK	IRRG	1.55	2.32		
1935-000	6	Kerr	9525100000	CHARLES K HICKEY JR ET AL	N FRK GUADALUPE RIVER	IRRG	8	8		
1936-000	6	Kerr	9523000000	WILLIAM H ARLITT JR ET UX	N FRK GUADALUPE RIVER	IRRG	17	6	5	
1936-000	6	Kerr	9523000000	WILLIAM H ARLITT JR ET UX	INDIAN CRK	IRRG	134	48		
1937-000	6	Kerr	9515200000	BOY SCOUTS- ALAMO AREA	BEAR CRK	REC			10	
1938-000	6	Kerr	9515000000	LOUIS H STUMBERG	N FRK GUADALUPE RIVER	IRRG	2	4		
1938-000	6	Kerr	9515000000	LOUIS H STUMBERG	N FRK GUADALUPE RIVER	IRRG	15	22		
1939-000	6	Kerr	9512000000	LOUIS H STRUMBERG	GRAPE CRK	IRRG	3	6	6	
1940-000	6	Kerr	9511000000	B E QUINN III ET AL	N FRK GUADALUPE RIVER	IRRG	32	16	10	
1941-000	6	Kerr	8154502000	DELMAR SPIER AGENT	TURTLE CRK	IRRG	6	9	5	
1943-000	6	Kerr	9505000000	J CONRAD PYLE, ET AL	N FRK GUADALUPE RIVER	MUNI	14			
1945-000	6	Kerr	9485010000	JOHN P HILL	N FRK GUADALUPE RIVER	IRRG	25	20		
1946-000	6	Kerr	9485000000	JOHN P HILL ADMINISTRATOR	N FRK GUADALUPE RIVER	IRRG	11	9		
1947-000	6	Kerr	9480000000	GUAD VALLEY LOT OWNERS ASSN	N FRK GUADALUPE RIVER	IRRG	6	10		AMEND 3/6/91

APPENDIX 3A. (Continued) Authorized Surface Water Rights as Extracted from TCEQ's Active Water Rights Master File

Water Right Number	Type	County	River Order Permit	Name	Stream	Use	Amount in Ac-Ft/Yr	Acreage	Res Cap in Ac-Ft	Remarks
1947-000	6	Kerr	9480000000	GUAD VALLEY LOT OWNERS ASSN	N FRK GUADALUPE RIVER	MUNI	3			
1948-000	6	Kerr	9489000000	JOHN H DUNCAN	BRUSHY CRK	IRRG	7	7		
1949-000	6	Kerr	9488000000	WILLIAM O CARTER, TRUSTEE	HONEY CRK	IRRG	6	2		OUT OF A 80 ACRE TRACT
1949-000	6	Kerr	9488000000	WILLIAM O CARTER, TRUSTEE	HONEY CRK	IRRG	27	9		
1950-000	6	Kerr	9487000000	JOHN H DUNCAN	HONEY CRK	IRRG	6	20	13	ALSO USE 7
1953-000	6	Kerr	9476000000	LAURA B LEWIS ET VIR	N FRK GUADALUPE RIVER	IRRG	40	24		
1956-000	6	Kerr	9897000000	RIVER INN ASSOC OF UNIT OWNERS	S FRK GUADALUPE RIVER	REC			50	
1956-000	6	Kerr	9897000000	RIVER INN ASSOC OF UNIT OWNERS	S FRK GUADALUPE RIVER	MUNI	10			AMEND 4/19/84, 1/4/85
1957-000	6	Kerr	9880000000	BILLIE R VALICEK	S FRK GUADALUPE RIVER	REC			10	
1958-000	6	Kerr	9780000000	T J MOORE ESTATE	CYPRESS CRK	IRRG	20	10	100	
1961-000	6	Kerr	9670000000	LAVERNE CRIDER MOORE ET VIR	S FRK GUADALUPE RIVER	MUNI	3			
1961-000	6	Kerr	9670000000	LAVERNE CRIDER MOORE ET VIR	S FRK GUADALUPE RIVER	IRRG	1	3		
1963-000	6	Kerr	9620000000	LAWRENCE L GRAHAM ET AL	S FRK GUADALUPE RIVER	IRRG	2	12	21	AMEND 9/10/85
1963-000	6	Kerr	9620000000	LAWRENCE L GRAHAM ET AL	S FRK GUADALUPE RIVER	REC			16	AMENDS 5/26/83 CHG PUR USE & ADD RES
1964-000	6	Kerr	9400000000	VIRGINIA MOORE JOHNSTON	TEGENER	IRRG	10	10	12	
1967-000	6	Kerr	9305000000	SARAH HICKS BUSS	UNNAMED TRIB GUADALUPE RIVER	REC	20			ALSO USE 1, AMEND 3/19/91
1968-000	6	Kerr	9261000000	LOUIS DOMINGUES	GUADALUPE RIVER	IRRG	10	20		
1969-000	6	Kerr	9260000000	TOMMIE SMITH BLACKBURN	GUADALUPE RIVER	INDU	15		15	USE 2: MILLING
1969-000	6	Kerr	9260000000	TOMMIE SMITH BLACKBURN	KELLY CRK	IRRG	49	80		USE 3 - DIVERTING FROM KELLY CREEK
1969-000	6	Kerr	9260000000	TOMMIE SMITH BLACKBURN	GUADALUPE RIVER	IRRG	59			USE 3 - DIVERTING FROM GUADALUPE RIVER
1969-000	6	Kerr	9260000000	TOMMIE SMITH BLACKBURN	GUADALUPE RIVER	HYDRO				USE 5; NONCONSUMPTIVE
1970-000	6	Kerr	9220000000	CARL HAWKINS	GUADALUPE RIVER	MUNI	10			
1970-000	6	Kerr	9220000000	CARL HAWKINS	GUADALUPE RIVER	IRRG	32	25		
1971-000	6	Kerr	9140000000	COUNTY OF KERR	GUADALUPE RIVER	REC			450	
1972-000	6	Kerr	9110000000	WESLEY ELLEBRACHT	WELSH BR	IRRG	0.8	0.8		
1972-000	6	Kerr	9110000000	WELCH CREEK PARTNERS LTD	WELSH BR	IRRG	5.15	5.15		
1972-000	6	Kerr	9110000000	ARANSAS BAY COMPANY	WELSH BR	IRRG	0.05	0.05		
1973-000	6	Kerr	9100000000	SHELTON RANCHES INC	SMITHS BR	IRRG	10	10	6	

APPENDIX 3A. (Continued) Authorized Surface Water Rights as Extracted from TCEQ's Active Water Rights Master File

Water Right Number	Type	County	River Order Permit	Name	Stream	Use	Amount in Ac-Ft/Yr	Acreage	Res Cap in Ac-Ft	Remarks
1974-000	6	Kerr	9050000000	SHELTON RANCHES INC	SMITHS BR	IRRG	70	35	15	ALSO JOHNSON CREEK
1975-000	6	Kerr	9025000000	TEXAS PARKS & WILDLIFE DEPT	FESSENDEN BR	INDU	400			FISH HATCHERY & GAME PRESERVE
1975-000	6	Kerr	9025000000	TEXAS PARKS & WILDLIFE DEPT	FESSENDEN BR	INDU	5780		72	2 IMP & A POND; USES 3, 1 & 7; EXP 2012
1976-000	6	Kerr	8950000000	F P ZOCH III TRUST & ZEE RANCH	FESSENDEN BR	IRRG	29	14		
1976-000	6	Kerr	8950000000	F P ZOCH III TRUST & ZEE RANCH	FESSENDEN BR	REC			184	
1977-000	6	Kerr	8839000000	TEXAS CATHOLIC BOYS' HOME	JOHNSON CRK	IRRG	23	23	23	
1978-000	6	Kerr	8815000000	A J RUST	JOHNSON CRK	IRRG	33	65		
1979-000	6	Kerr	8808000000	KEITH S MEADOW	BYAS CRK	IRRG	18	6		
1980-000	6	Kerr	8805000000	A L MOORE	JOHNSON CRK	IRRG	12	6		
1981-000	6	Kerr	8800000000	JACK D CLARK JR ET AL	JOHNSON CRK	IRRG	32	16		
1981-000	6	Kerr	8800000000	JACK D CLARK JR ET AL	JOHNSON CRK	IRRG	143	76		OUT OF A 111.9 ACRE TRACT
1982-000	6	Kerr	8775000000	LOLA DEAN SMITH	JOHNSON CRK	IRRG	133	50	12	
1983-000	6	Kerr	8770000000	N V MAMIMAR	JOHNSON CRK	IRRG	32	17		JOINTLY OWN 32 & 67 AF TO IRR 17 & 35 AC
1983-000	6	Kerr	8770000000	N V MAMIMAR	JOHNSON CRK	IRRG	67	35		JOINTLY OWN 32 & 67 AF TO IRR 17 & 35 AC
1983-000	6	Kerr	8770000000	DAVID J COPELAND ET UX	JOHNSON CRK	IRRG				JOINTLY OWN 32 & 67 AF TO IRR 17 & 35 AC
1983-000	6	Kerr	8770000000	DAVID J COPELAND ET UX	JOHNSON CRK	IRRG				JOINTLY OWN 32 & 67 AF TO IRR 17 & 35 AC
1984-000	6	Kerr	8750000000	MICHAEL E & GAIL SEARS	JOHNSON CRK	IRRG	1	2		
1985-000	6	Kerr	8746000000	ROBERT B O'CONNOR JR ET UX	JOHNSON CRK	IRRG	80	31		
1987-000	6	Kerr	8744000000	REGINALD E WARREN JR	JOHNSON CRK	IRRG	90	30		
1988-000	6	Kerr	8720000000	JIMMIE L QUERNER SR ESTATE	FALL BR	IRRG	128	64		ALSO GILLESPIE CO
1990-000	6	Kerr	8650000000	DOROTHY L JENKINS ET AL	JOHNSON CRK	IRRG	3	1		
1991-000	6	Kerr	8615001000	LAZY HILLS GUEST RANCH INC	HENDERSON BR	IRRG	21	28		
1992-000	6	Kerr	8600000000	MARK A RYLANDER ET AL	JOHNSON CRK	IRRG	23	15		
1993-000	6	Kerr	8550000000	ROY LITTLEFIELD	JOHNSON CRK	IRRG	50	50	4	
1994-000	6	Kerr	8500000000	M H & MARY FRANCES MONTGOMERY	GUADALUPE RIVER	IRRG	5	4		
1995-000	6	Kerr	8451000000	HENRY GRIFFIN CONSTRUCTION CO	GOAT CRK	IRRG	11	11	6	
1996-000	6	Kerr	8287000000	KERRVILLE, CITY OF	GUADALUPE RIVER	MUNI	150			AMEND 3/19/91, 4/10/98: DIV PT #4.SC.

APPENDIX 3A. (Continued) Authorized Surface Water Rights as Extracted from TCEQ's Active Water Rights Master File

Water Right Number	Type	County	River Order Permit	Name	Stream	Use	Amount in Ac-Ft/Yr	Acreage	Res Cap in Ac-Ft	Remarks
1996-000	6	Kerr	8287000000	KERRVILLE, CITY OF	GUADALUPE RIVER	IRRG	75	44	75	AMEND 3/19/91, 4/10/98: DIV PT #4.SC.
1997-000	6	Kerr	8310000000	DARRELL G LOCHTE ET AL	GUADALUPE RIVER	MINE	143			
1997-000	6	Kerr	8310000000	DARRELL G LOCHTE ET AL	GUADALUPE RIVER	INDU	2			
1998-000	6	Kerr	8295000000	C W SUNDAY	TOWN CRK	IRRG	22.3	22.3	10	
1998-000	6	Kerr	8295000000	JOSE A LOPEZ ET UX	TOWN CRK	IRRG	4.18	4.18		
1999-000	6	Kerr	8297000000	KERRVILLE STATE HOSPITAL	UNNAMED TRIB GUADALUPE RIVER	REC	44		44	
2000-000	6	Kerr	8260010000	RIVERHILL COUNTRY CLUB INC	GUADALUPE RIVER	IRRG	350	160	70	8/31/87
2001-000	6	Kerr	8255000000	CARL D. MEEK	GUADALUPE RIVER	IRRG	295	194		AMEND 4/9/92,5/12/95.DIFF PRIORITY DATES
2002-000	6	Kerr	8230000000	COMANCHE TRACE RANCH & GOLF CL	GUADALUPE RIVER	IRRG	136	99		
2003-000	6	Kerr	8250000000	WHEATCRAFT, INC.	GUADALUPE RIVER	IRRG	42	21		
2003-000	6	Kerr	8250000000	SHELTON RANCH CORPORATION	GUADALUPE RIVER	MINE	10			
2004-000	6	Kerr	8200000000	COUNTY OF KERR	GUADALUPE RIVER	REC			720	ALSO USE 8
2005-000	6	Kerr	8185500000	HARRIET BOCKHOFF ESTATE	GUADALUPE RIVER	IRRG	59	98		
2006-000	6	Kerr	8174000000	FARM CREDIT BANK OF TEXAS	GUADALUPE RIVER	IRRG	179.06	512.55		AMEND 2/3/88,6/18/90. MAX COMB. CFS:4.0
2006-000	6	Kerr	8174000000	FARM CREDIT BANK OF TEXAS	GUADALUPE RIVER	IRRG	83.94			AMEND 2/3/88, 6/18/90
2006-000	6	Kerr	8174000000	1967 SHELTON TRUSTS PART ET AL	GUADALUPE RIVER	IRRG	106.9	78.55		AMEND 2/3/88, 6/18/90
2006-000	6	Kerr	8174000000	1967 SHELTON TRUSTS PART ET AL	GUADALUPE RIVER	IRRG	50.1			AMEND 2/3/88, 6/18/90
2006-000	6	Kerr	8174000000	KENNETH W WHITEWOOD ET UX	GUADALUPE RIVER	IRRG	34.04			AMEND 2/3/88, 6/18/90, 11/22/96
2006-000	6	Kerr	8174000000	KENNETH W WHITEWOOD ET UX	GUADALUPE RIVER	IRRG	15.96			AMEND 2/3/88, 6/18/90, 11/22/96
2006-000	6	Kerr	8174000000	KENNETH W WHITEWOOD ET UX	GUADALUPE RIVER	IRRG	100	76		AMEND 2/3/88, 6/18/90, 11/22/96
2007-000	6	Kerr	8160000000	RAY ELLISON JR	SPRING CRK	IRRG	31	31	50	
2008-000	6	Kerr	8156160000	LUTHERAN CAMP CHRYSALIS	TURTLE CRK	MUNI	11		12	
2009-000	6	Kerr	8155750000	FRANCIS C & WILLADEAN BOLEN	BUSHWACK CRK	IRRG	5	5	5	
2010-000	6	Kerr	8155700000	G ROBERT SWANTNER JR ET UX	BUSHWACK CRK	IRRG	7	5	5	OUT OF 68.8 ACRE TRACT
2011-000	6	Kerr	8155000000	H J GRUY	TURTLE CRK	IRRG	80	50	10	
2012-000	6	Kerr	8154501000	SANDRA BLAIR	TURTLE CRK	IRRG	1	1	5	
2013-000	6	Kerr	8154500000	FELIX R & LILLIAN STEILER REAL	WEST CRK	IRRG	11	12		
2014-000	6	Kerr	8152000000	LEAH MARTHA STEPHENS	TURTLE CRK	IRRG	6.36	5.63		

APPENDIX 3A. (Continued) Authorized Surface Water Rights as Extracted from TCEQ's Active Water Rights Master File

Water Right Number	Type	County	River Order Permit	Name	Stream	Use	Amount in Ac-Ft/Yr	Acreage	Res Cap in Ac-Ft	Remarks
2014-000	6	Kerr	8152000000	BENNO OOSTERMAN ET UX	TURTLE CRK	IRRG	6.36	5.63		
2014-000	6	Kerr	8152000000	JOHN M LEBOLT TRUSTEE	TURTLE CRK	IRRG	9.02	7.98		
2015-000	6	Kerr	8151000000	JAMES E NUGENT	GUADALUPE RIVER	IRRG	27	21		
2016-000	6	Kerr	8150500000	DORIS J HODGES	GUADALUPE RIVER	IRRG	8	8		
2017-000	6	Kerr	8050000000	COUNTY OF KERR	GUADALUPE RIVER	REC			87	ALSO USE 8
2018-000	6	Kerr	8049000000	LEE ANTHONY MOSTY	GUADALUPE RIVER	IRRG	154	94		
2020-000	6	Kerr	7970000000	ROBERT LEE MOSTY	GUADALUPE RIVER	IRRG	60	30		
2021-000	6	Kerr	7940000000	RAYMOND F MOSTY ET AL	GUADALUPE RIVER	IRRG	103	45	5	
2022-000	6	Kerr	7950000000	ROBERT LEE MOSTY	GUADALUPE RIVER	IRRG	17	119	20	
2023-000	6	Kerr	7935000000	ROY A GREEN	GUADALUPE RIVER	IRRG	7	3		
2024-000	6	Kerr	7924990000	CARL E RHODES	GUADALUPE RIVER	IRRG	114	125		
2025-000	6	Kerr	7925000000	HARRY J WRAY	GUADALUPE RIVER	IRRG	155	80		JOINTLY OWNS 155 AF TO IRR 80 ACRES
2025-000	6	Kerr	7925000000	DAVID B WRAY	GUADALUPE RIVER	IRRG				JOINTLY OWNS 155 AF TO IRR 80 ACRES
2025-000	6	Kerr	7925000000	BYNO SALSMAN ET UX	GUADALUPE RIVER	IRRG				JOINTLY OWNS 155 AF TO IRR 80 ACRES
2026-000	6	Kerr	7920000000	ELGIN JUNG	GUADALUPE RIVER	IRRG	3.309	2.118		
2026-000	6	Kerr	7920000000	ZANE H ROBINSON ET UX	GUADALUPE RIVER	IRRG	53.945	34.52		
2026-000	6	Kerr	7920000000	RONNIE W SCHLOTTMAN ET UX	GUADALUPE RIVER	IRRG	17.83	11.41		
2026-000	6	Kerr	7920000000	KENNETH W WHITEWOOD ET UX	GUADALUPE RIVER	IRRG	149.916	44.72		AMENDED 11/22/96
2029-000	6	Kerr	7710000000	ROLAND WALTERS	PRISON CANYON	IRRG	25	200	420	& CO 010, 10/5/82 ADD DIV PT
2030-000	6	Kerr	7704000000	JAMES S ERNST	UNNAMED TRIB VERDE CRK	IRRG	247		120	
2030-000	6	Kerr	7704000000	PETE R SMITH	UNNAMED TRIB VERDE CRK	IRRG	19			
2031-000	6	Kerr	7701000000	JOSEPH PAUL MILLER ET UX	GUADALUPE RIVER	IRRG	115	80		AMEND 11/4/85
2032-000	6	Kerr	7700700000	DAVID M LEIBOWITZ ET UX	GUADALUPE RIVER	IRRG	10	6		
2033-000	6	Kerr	7699900000	JAVIER G REYES ET UX	GUADALUPE RIVER	IRRG	90	90		
2034-000	6	Kerr	7699500000	CHESTER P HEINEN ET AL	GUADALUPE RIVER	IRRG	2	6		
2037-000	6	Kerr	7652500000	GENE ARTHUR ALLERKAMP	CYPRESS CRK	IRRG	5	6.33		
2037-000	6	Kerr	7652500000	JANICE CHARLOTTE BULLARD	CYPRESS CRK	IRRG	5	6.34		
2037-000	6	Kerr	7652500000	ROMAN LUNA ET UX	CYPRESS CRK	IRRG	10	12.67		
2037-000	6	Kerr	7652500000	CURTIS BERNARD ALLERKAMP	CYPRESS CRK	IRRG	5	6.33		

APPENDIX 3A. (Continued) Authorized Surface Water Rights as Extracted from TCEQ's Active Water Rights Master File

Water Right Number	Type	County	River Order Permit	Name	Stream	Use	Amount in Ac-Ft/Yr	Acreage	Res Cap in Ac-Ft	Remarks
2037-000	6	Kerr	7652500000	WERNER WAYNE ALLERKAMP	CYPRESS CRK	IRRG	5	6.33		
2038-000	6	Kerr	7652000000	HARRY E REEH	CYPRESS CRK	IRRG	15	15		
2039-000	6	Kerr	7650500000	FRED SAUR	CYPRESS CRK	IRRG	7	7		
2040-000	6	Kerr	7650000000	A C & DOROTHY PFEIFFER	CYPRESS CRK	IRRG	10	5		
2041-000	6	Kerr	7645000000	THOMAS L BRUNDAGE ET AL	CYPRESS CRK	IRRG	134	57		AMEND 2/1/85
2042-000	6	Kerr	7644800000	E J & VIRGINIA DOWER	CYPRESS CRK	IRRG	209	125		
2043-000	6	Kerr	7644600000	MARY LEE EDWARDS	CYPRESS CRK	IRRG	19.57	14.68		
2043-000	6	Kerr	7644600000	EDGAR SEIDENSTICKER ET UX	CYPRESS CRK	IRRG	16.85	12.63		
2043-000	6	Kerr	7644600000	L J MANNERING ET UX	CYPRESS CRK	IRRG	3.58	2.69		
2437-000	6	Kerr	9550000000	CHLOE CULLUM KEARNEY ET AL	N FRK GUADALUPE RIVER	REC			100	D&L. RESERVOIR JOINTLY OWNED BY SEVERAL.
2437-000	6	Kerr	9550000000	DAN W BACON ET UX	N FRK GUADALUPE RIVER	REC				D&L. RESERVOIR JOINTLY OWNED BY SEVERAL.
2438-000	6	Kerr	9528000000	LUTZ ISSLIEB ET AL	N FRK GUADALUPE RIVER	IRRG	30	18	30	
2439-000	6	Kerr	9510000000	DALE B AND MARSHA G ELMORE	N FRK GUADALUPE RIVER	IRRG	8	8	20	AMEND 10/29/90
2440-000	6	Kerr	9507000000	L F SCHERER	N FRK GUADALUPE RIVER	IRRG	1	1		
2441-000	6	Kerr	9490000000	SILAS B RAGSDALE	N FRK GUADALUPE RIVER	IRRG	21	105		
2442-000	6	Kerr	9486000000	LUTHER GRAHAM	HONEY CRK	IRRG	28	14	17	
2443-000	6	Kerr	9476500000	JOHN H DUNCAN	HONEY CRK	IRRG	40	20	25	
2444-000	6	Kerr	9980000000	BRUCE F. HARRISON	S FRK GUADALUPE RIVER	IRRG	6	3	10	
2444-000	6	Kerr	9980000000	BRUCE F. HARRISON	S FRK GUADALUPE RIVER	REC			17	
2445-000	6	Kerr	9680000000	CAMP MYSTIC INC	CYPRESS CRK	IRRG	12	15		
2445-000	6	Kerr	9680000000	CAMP MYSTIC INC	CYPRESS CRK	MUNI	14		20	
2446-000	6	Kerr	9675000000	BOB/KAT INC	S FRK GUADALUPE RIVER	IRRG	10	10		
2446-000	6	Kerr	9675000000	BOB/KAT INC	S FRK GUADALUPE RIVER	MUNI	10			
2447-000	6	Kerr	9625000000	CAMP LA JUNTA INC	S FRK GUADALUPE RIVER	IRRG	26	15	30	
2447-000	6	Kerr	9625000000	CAMP LA JUNTA INC	S FRK GUADALUPE RIVER	MUNI	14			& RECREATION
2448-000	6	Kerr	9350000000	ALICE CYNTHIA SIMKINS	TEGENER CRK	IRRG	6	5		
2449-000	6	Kerr	9310000000	BILLIE ZUBER ET AL	GUADALUPE RIVER	IRRG	17	25.5		AMEND 9/24/93:ADD ACREAGE.JUNIOR PRIORTY
2450-000	6	Kerr	7999000000	ROBERT L MOSTY ET AL	GUADALUPE RIVER	IRRG	158	117		

APPENDIX 3A. (Continued) Authorized Surface Water Rights as Extracted from TCEQ's Active Water Rights Master File

Water Right Number	Type	County	River Order Permit	Name	Stream	Use	Amount in Ac-Ft/Yr	Acreage	Res Cap in Ac-Ft	Remarks
3769-000	1	Kerr	8300010000	CITY OF KERRVILLE	GUADALUPE RIVER	MUNI	3603		840	
3769-000	1	Kerr	8300010000	CITY OF KERRVILLE	GUADALUPE RIVER	IRRG		192		USING 2450 AF WASTEWATER FROM SEWAGE.SC
3846-000	1	Kerr	7715000000	T & R PROPERTIES	PALMER CRK	REC	322		322	
3896-000	1	Kerr	8276000000	KENNETH W & MARCIA C MULFORD	RATTLESNAKE	MUNI			13	3 TRACTS 34.55 AC, ALSO REC
3904-000	1	Kerr	8275500000	CITY OF KERRVILLE	QUINLAN CRK	IRRG	80	56	10	& REC-2 RES-146-AC TR-EXPIRES 20 YEARS
4007-000	1	Kerr	7703100000	PECAN VALLEY RANCH OWNERS ASSO	ELM CRK	REC			157	ALSO DOMESTIC & LIVESTOCK
4034-000	1	Kerr	9040000000	SHELTON RANCHES INC	JOHNSON CRK	REC			122	2 RES, SEE FILE, & ADJ 1974
4223-000	1	Kerr	9105000000	SHELTON RANCHES INC	JOHNSON CRK	IRRG	20	14	39	
4298-000	1	Kerr	8294800000	ALISON B MENCAROW LIVING TRUST	TOWN CRK	IRRG	12	18		AMEND 12/10/91
4486-000	1	Kerr	7644900000	JAY & HILDA POTH	CYPRESS CRK	IRRG	70	35		RATE SEE 18-2041
5060-000	1	Kerr	8710000000	HORACE COFER ASSOCIATES, INC	FALL BR CRK	IRRG	10	12		
5122-000	1	Kerr	8150800000	JAMES C STORM	GUADALUPE RIVER	IRRG	75	50	8	
5315-000	1	Kerr	8294000000	DANA G KIRK TRUSTEE	E TOWN CRK	OTHER				PRIVATE WATER
5322-000	1	Kerr	8705000000	E RAND SOUTHARD ET UX	FALL BR	REC				
5331-000	1	Kerr	9660000000	KATHLEEN B FLOURNOY, ET AL	S FRK GUADALUPE RIVER	MUNI	15		30	& RECREATION
5331-000	1	Kerr	9660000000	KATHLEEN B FLOURNOY, ET AL	S FRK GUADALUPE RIVER	IRRG	96	30		
5348-000	1	Kerr	9526000000	BRYON DONZIS	N FRK GUADALUPE RIVER	IRRG	5	4		
5352-000	1	Kerr	9650000000	BONITA OWNERS ASSOC INC	S FRK GUADALUPE RIVER	IRRG	2	2		
5394-000	1	Kerr	8300010000	UPPER GUADALUPE RIVER AUTH	GUADALUPE RIVER	MUNI	1661			FIRM YIELD BASIS. AMENDED 4/10/98. SCS.
5394-000	1	Kerr	8300010000	UPPER GUADALUPE RIVER AUTH	GUADALUPE RIVER	MUNI	339			FIRM YIELD BASIS. AMENDED 4/10/98. SCS.
5394-000	1	Kerr	8300010000	CITY OF KERRVILLE	GUADALUPE RIVER	MUNI	761			FIRM YIELD BASIS. AMENDED 4/10/98. SCS.
5394-000	1	Kerr	8300010000	CITY OF KERRVILLE	GUADALUPE RIVER	MUNI	339			RUN OF RIVER BASIS. AMENDED 4/10/98.SCS
5394-000	1	Kerr	8300010000	CITY OF KERRVILLE	GUADALUPE RIVER	MUNI	1069			RUN OF RIVER BASIS. AMENDED 4/10/98.SCS
5402-000	1	Kerr	8155300000	TURTLE CREEK INDUSTRIES INC	TURTLE CRK	REC				
5444-000	1	Kerr	8490000000	EUGENE D ELLIS ET UX	GUADALUPE RIVER	IRRG	10	25.5		
5479-000	1	Kerr	7701250000	CITY SOUTH MANAGEMENT CORP	GUADALUPE RIVER	IRRG	566	283		AMENDED 3/13/98

APPENDIX 3A. (Continued) Authorized Surface Water Rights as Extracted from TCEQ's Active Water Rights Master File

Water Right Number	Type	County	River Order Permit	Name	Stream	Use	Amount in Ac-Ft/Yr	Acreage	Res Cap in Ac-Ft	Remarks
5495-000	1	Kerr	9800000000	LOIS & JOSEPH WESSENDORF ET AL	S FRK GUADALUPE RIVER	REC			9	
5521-000	1	Kerr	8300050000	DON D WILSON	GUADALUPE LAKE	IRRG	30	30		GUADALUPE RIVER
5531-000	1	Kerr	8185700000	LEE ROY COSPER ET UX	GUADALUPE RIVER	IRRG	80	40		
5536-000	1	Kerr	7701350000	ROBERT H & CHARLOTTE JENNINGS	GUADALUPE RIVER	IRRG	400	200		
5541-000	1	Kerr	9476150000	BASHARDT LTD	N FRK GUADALUPE RIVER	IRRG	14	15		
5641-000	1	Kerr		MARLIN R MARCUM		IRRG	1	2		SUBJECT TO MAINT OF CONTRACT & AGREEMENT
5737-000	1	Kerr		SYLVIA SIEKER		IRRG	1			
12246-000	1	Kerr		ELIZABETH CARTER		REC			6.84	
12938-000	1	Kerr		RIVER MOUNTAIN RANCH		RFC				
2671-000	6	Kinney	4950000000	MAVERICK CO WCID 1	RIO GRANDE	IRRG	134900	45000		& CO 162, AMEND 8/22/86,9/22/88,10/30/98
2671-000	6	Kinney	4950000000	MAVERICK CO WCID 1	RIO GRANDE	MUNI	2049			AMEND 8/22/86,9/22/88,10/30/98
2671-000	6	Kinney	4950000000	MAVERICK CO WCID 1	RIO GRANDE	REC	196			AMEND 8/22/86,9/22/88,10/30/98
2671-000	6	Kinney	4950000000	MAVERICK CO WCID 1	RIO GRANDE	HYDRO	1085966			AMEND 8/22/86,9/22/88,10/30/98
2673-000	6	Kinney	4950000000	LENDELL MARTIN ET UX	MUD CRK	IRRG	52	35	16	
2674-000	6	Kinney	4950000000	CLYDE M BRADLEY	MUD CRK	IRRG	20	15		RATE SEE 23-2673
2675-000	6	Kinney	4950000000	SHERWOOD GAINES TRUSTEE	MUD CRK	IRRG	60	30		RATE SEE 23-2673
2676-000	6	Kinney	4950000000	JEWEL FOREMAN ROBINSON	PINTO CRK	IRRG	252	126		
2678-000	6	Kinney	4950000000	JOHNNY E RUTHERFORD	PINTO CRK	IRRG	135	90		
2679-000	6	Kinney	4950000000	CITY OF BRACKETTVILLE	LAS MORAS SPRING	MUNI	3			
2680-000	6	Kinney	4950000000	ELISE AULGUR HUNTSMAN ET AL	LAS MORAS CRK	IRRG	15	15		JOINT OWNER OF 15 AF TO IRR 15 ACRES
2680-000	6	Kinney	4950000000	ANN A LEGG & ERNESTINE A LOPEZ	LAS MORAS CRK	IRRG				JOINT OWNER OF 15 AF TO IRR 15 ACRES
2681-000	6	Kinney	4950000000	EARL H NOBLES	LAS MORAS CRK	IRRG	10	10		
2682-000	6	Kinney	4950000000	BERNARD C MEISCHEN ET AL	LAS MORAS CRK	IRRG	25	25		
2682-000	6	Kinney	4950000000	CHARLES W GAEBLER ET AL	LAS MORAS CRK	IRRG	75	75		+50 AF FROM 7 RES FOR STOCK RAISING
2683-000	6	Kinney	4950000000	ANDREW P MALINOVSKY JR	LAS MORAS CRK	IRRG	60	30		
2684-000	6	Kinney	4950000000	BEN S JONES	ELM CRK	IRRG	47	26	6	
2686-000	6	Kinney	4950000000	ROBERT H MEISCHEN, ET AL	LAS MORAS CRK	IRRG	300	300		
2686-000	6	Kinney	4950000000	ROBERT H MEISCHEN, ET AL	LAS MORAS CRK	MUNI	50			4 RESERVOIRS
2687-000	6	Kinney	4950000000	CELIA R DE PLAZA, ET AL	LAS MORAS CRK	IRRG	110	55		

APPENDIX 3A. (Continued) Authorized Surface Water Rights as Extracted from TCEQ's Active Water Rights Master File

Water Right Number	Type	County	River Order Permit	Name	Stream	Use	Amount in Ac-Ft/Yr	Acreage	Res Cap in Ac-Ft	Remarks
2913-000	6	Kinney	4950000000	MOODY RANCHES INC	RIO GRANDE	IRRG	5500	3000	17	
2913-000	6	Kinney	4950000000	MOODY RANCHES INC	RIO GRANDE	IRRG	500	250		
3071-000	6	Kinney	7023010000	LLOYD L DAVIS	W NUECES RIVER	OTHER			25	IMPOUNDMENT
4365-000	1	Kinney	7028000000	ROBERT L MOODY JR	SPRING BR	REC	10		42	4 RES
4389-000	1	Kinney	4950000000	FORT CLARK SPRINGS ASSOC INC	LAS MORAS CRK	REC				
4517-000	1	Kinney	4950000000	FORT CLARK SPRINGS ASSOC INC	LAS MORAS CRK	REC			3	
1610-000	9	Medina	5700000000	L KEN EVANS	MEDINA RIVER	IRRG	20			LAKE MEDINA, EXP 2016
3016-000	6	Real	9615000000	JOHN H WATTS III ET UX	E PRONG NUECES RIVER	IRRG	4	2		SC. TWO PRIORITY DATES. AMEND 7/10/98
3016-000	6	Real	9615000000	JOHN H WATTS III ET UX	E PRONG NUECES RIVER	IRRG	54	27		SC. TWO PRIORITY DATES. AMEND 7/10/98
3018-000	6	Real	9450000000	LEWIS CLECKLER ET UX	SPRING CRK	IRRG	22.7	12.1		BULLHEAD HOLLOW
3018-000	6	Real	9450000000	EL CAMINO GIRL SCOUT COUNCIL	SPRING CRK	IRRG	7.3	3.9		BULLHEAD HOLLOW
3019-000	6	Real	9410000000	SARAH M DAVIS	BULLHEAD CRK	IRRG	80	40		
3019-000	6	Real	9410000000	SARAH M DAVIS	BULLHEAD CRK	IRRG		13		
3020-000	6	Real	9320000000	H C MCCARTY JR ET UX	BULLHEAD CRK	IRRG	34.736	17.368		
3020-000	6	Real	9320000000	F WALTER CONRAD JR ET UX	BULLHEAD CRK	IRRG	85.264	42.632		
3021-000	6	Real	9198500000	DSD, INC	BULLHEAD CRK	IRRG	418	210		
3022-000	6	Real	9190000000	MARVIN L BERRY	UNNAMED TRIB NUECES RIVER	IRRG	259	300	14	TRIB OF NUECES RIVER
3022-000	6	Real	9190000000	MARVIN L BERRY	UNNAMED TRIB NUECES RIVER	IRRG	485			
3025-000	6	Real	9150000000	WILLIAM C & WANDA LEA LANE	DRY CRK	IRRG	40	20	1	
3026-000	6	Real	9075000000	JOHN A DANIEL ET UX	DRY CRK	IRRG	16	8	90	
3027-000	6	Real	9050000000	J F ALSOP	DRY CRK	IRRG	20	10		
3028-000	6	Real	9040000000	CLARENCE W HARRISON ET UX	DRY CRK	IRRG	15.43	7.72	43	
3028-000	6	Real	9040000000	CLARENCE W HARRISON ET UX	DRY CRK	REC			4	
3028-000	6	Real	9040000000	W THOMAS TAYLOR ET UX	DRY CRK	IRRG	4.36	2.18		
3029-000	6	Real	9008000000	HENRY D ENGELKING	NUECES RIVER	IRRG	43	52		
3034-000	6	Real	9004000000	HERBERT C JEFFRIES ET UX	NUECES RIVER	IRRG		2		SEE ADJ 3030
3036-000	6	Real	9000000000	SALVADOR ORTIZ ET AL	NUECES RIVER	IRRG	125	50		
3037-000	6	Real	8950000000	DAVID WELDON TINDLE	NUECES RIVER	IRRG	25	25		

APPENDIX 3A. (Continued) Authorized Surface Water Rights as Extracted from TCEQ's Active Water Rights Master File

Water Right Number	Type	County	River Order Permit	Name	Stream	Use	Amount in Ac-Ft/Yr	Acreage	Res Cap in Ac-Ft	Remarks
3050-000	6	Real	8000000000	W A MALEY	E CAMP WOOD CRK	IRRG	28	14		
3051-000	6	Real	7980000000	ROBERT J LLOYD ET UX	E CAMP WOOD CRK	IRRG	1.42	1.42		
3051-000	6	Real	7980000000	WANNA LOU LLOYD	E CAMP WOOD CRK	IRRG	4.08	4.08		
3052-000	6	Real	7970000000	BARRY BLANKS MCHALEK ET UX	E CAMP WOOD CRK	IRRG	5	5		SEE ADJ 3051
3053-000	6	Real	7960000000	BARRY BLANKS MCHALEK ET UX	E CAMP WOOD CRK	IRRG	1	1		SEE ADJ 3051
3054-000	6	Real	7950000000	JOHN CHAMBERS ET AL	E CAMP WOOD CRK	IRRG	10	10		SEE ADJ 3051
3055-000	6	Real	7900000000	WILLIAM C & PATRICIA K SUTTON	E CAMP WOOD CRK	IRRG	105	130	2	
3056-000	6	Real	7810000000	ROY GIBBENS	E CAMP WOOD CRK	IRRG	18	9	4	
3056-000	6	Real	7810000000	ROY GIBBENS	E CAMP WOOD CRK	IRRG	2			
3057-000	6	Real	7800000000	MAGELEE V SWIFT	E CAMP WOOD CRK	IRRG	21	16	8	SEE ADJ 3056
3057-000	6	Real	7800000000	MAGELEE V SWIFT	E CAMP WOOD CRK	IRRG	10	4	4	
3058-000	6	Real	7740000000	DOROTHY MERRITT ANDERSON	NUECES RIVER	IRRG	8	8		
3059-000	6	Real	7730000000	F L JR & CHARLOTTE HATLEY	NUECES RIVER	IRRG	11	7		
3060-000	6	Real	7631000000	E E GILDART	NUECES RIVER	IRRG	42	21		
3060-000	6	Real	7631000000	E E GILDART	NUECES RIVER	IRRG	54	26		
3060-000	6	Real	7631000000	E E GILDART	NUECES RIVER	IRRG	35	46		
3061-000	6	Real	7630000000	E E GILDART	NUECES RIVER	IRRG	31	31		
3062-000	6	Real	7550000000	JOANNE FRIEND	NUECES RIVER	IRRG	46	46		
3145-000	6	Real	3900000000	GEORGE S HAWN INTERESTS ET AL	S P/L P W FRIO RIVER	REC			27	
3145-000	6	Real	3900000000	GEORGE S HAWN INTERESTS ET AL	S P/L P W FRIO RIVER	REC			68	
3145-000	6	Real	3900000000	GEORGE S HAWN INTERESTS ET AL	S P/L P W FRIO RIVER	IRRG	156	78		
3146-000	6	Real	3850000000	JAMES W HALE ET AL	W FRIO RIVER	REC			16	
3147-000	6	Real	3810000000	DIAMOND J RANCH INC	W FRIO RIVER	IRRG	165	55		
3148-000	6	Real	3750000000	H. E. BUTT FOUNDATION	E FRIO RIVER	REC	3.5		10	
3148-000	6	Real	3750000000	H. E. BUTT FOUNDATION	E FRIO RIVER	IRRG	6.5	2		UPPER SINGING HILLS RESERVOIR
3148-000	6	Real	3750000000	H. E. BUTT FOUNDATION	E FRIO RIVER	REC	11		11	UNNAMED DOWNSTREAM RESERVOIR (D-0340)
3148-000	6	Real	3750000000	H. E. BUTT FOUNDATION	E FRIO RIVER	IRRG	34.8	12.9		UNNAMED RESERVOIR (D-0340)

APPENDIX 3A. (Continued) Authorized Surface Water Rights as Extracted from TCEQ's Active Water Rights Master File

Water Right Number	Type	County	River Order Permit	Name	Stream	Use	Amount in Ac-Ft/Yr	Acreage	Res Cap in Ac-Ft	Remarks
3148-000	6	Real	3750000000	H. E. BUTT FOUNDATION	E FRIO RIVER	IRRG	6.7	2.5		UNNAMED RESERVOIR (D-0340)
3148-000	6	Real	3750000000	H. E. BUTT FOUNDATION	E FRIO RIVER	REC	25.08		25.08	LINNET'S WINGS DAM (D-0220);AMEND 3/91
3148-000	6	Real	3750000000	H. E. BUTT FOUNDATION	E FRIO RIVER	IRRG	3.2	1.2		LINNET'S WINGS DAM (D-0220)
3148-000	6	Real	3750000000	H. E. BUTT FOUNDATION	E FRIO RIVER	REC	34		68.7	LAITY LODGE DAM (D-0240);AF/WATERFALL
3148-000	6	Real	3750000000	H. E. BUTT FOUNDATION	E FRIO RIVER	IRRG	4	2		LAITY LODGE DAM (D-0240)
3148-000	6	Real	3750000000	H. E. BUTT FOUNDATION	E FRIO RIVER	REC	5.51		5.51	LOWER SINGING HILLS DAM (D-0280)
3148-000	6	Real	3750000000	H. E. BUTT FOUNDATION	E FRIO RIVER	IRRG	4.1	1.5		LOWER SINGING HILLS DAM (D-0280)
3148-000	6	Real	3750000000	H. E. BUTT FOUNDATION	E FRIO RIVER	REC	2.64		2.64	SILVER CREEK DAM (D-0300)
3148-000	6	Real	3750000000	H. E. BUTT FOUNDATION	E FRIO RIVER	REC	0.24		0.24	LOWER SILVER CREEK DAM (D-0320)
3148-000	6	Real	3750000000	H. E. BUTT FOUNDATION	E FRIO RIVER	REC	17.86		17.86	ECHO VALLEY DAM (D-0360)
3149-000	6	Real	3660000000	ORA L ROGERS ESTATE	E FRIO RIVER	IRRG	30	28		
3150-000	6	Real	3655000000	R F BINDOCK	E FRIO RIVER	IRRG	3	11		
3151-000	6	Real	3620000000	KATHERINE MAXINE MORELAND	E FRIO RIVER	IRRG	67	30		
3152-000	6	Real	3600000000	DAN AULD, JR	E FRIO RIVER	IRRG	324	162		
3153-000	6	Real	3490000000	JOHN J BURDITT, ET AL	UNNAMED TRIB E FRIO RIVER	IRRG	15	50		
3153-000	6	Real	3490000000	JOHN J BURDITT, ET AL	UNNAMED TRIB E FRIO RIVER	IRRG	23			
3154-000	6	Real	3430000000	JAMES TREES	YOUNGBLOOD SPRING	IRRG	2	6		
3155-000	6	Real	3420000000	LOTTIE N WRIGHT	FRIO RIVER	IRRG	164	43		
3156-000	6	Real	3400000000	H P COOPER ET AL	FRIO RIVER	IRRG	20	22		
3156-000	6	Real	3400000000	H P COOPER ET AL	FRIO RIVER	IRRG	2			
3157-000	6	Real	3350000000	E F BAYOUTH, MD PENSION PLAN	FRIO RIVER	IRRG	250	125		AMEND 1/9/85. CURRENT OWNER UNKNOWN 5/98
3158-000	6	Real	3375000000	LOMBARDY IRRIGATION CO	FRIO RIVER	IRRG	1600	800	6	ALSO COUNTY 232
3159-000	6	Real	3294000000	SAM G HARRISON	FRIO RIVER	IRRG	140	70		
3160-000	6	Real	3290000000	GRACIA BASSETT HABY	FRIO RIVER	IRRG	60	100		JOINTLY OWNS 60 AF TO IRR 100 ACRES
3160-000	6	Real	3290000000	THEODORE R REED TRUSTEE	FRIO RIVER	IRRG				JOINTLY OWNS 60 AF TO IRR 100 ACRES
3161-000	6	Real	3289500000	R L HUBBARD	DRY FRIO CRK	IRRG	17	21		

APPENDIX 3A. (Continued) Authorized Surface Water Rights as Extracted from TCEQ's Active Water Rights Master File

Water Right Number	Type	County	River Order Permit	Name	Stream	Use	Amount in Ac-Ft/Yr	Acreage	Res Cap in Ac-Ft	Remarks
3162-000	6	Real	3287500000	CARL A. DETERING, JR., ET AL	UNNAMED TRIB BUFFALO CRK	IRRG	5	25	15	
3180-000	6	Real	2799000000	LANA J STORMONT	UNNAMED TRIB W SABINAL RIVER	IRRG	5	10		
3878-000	1	Real	3645000000	C B SLABAUGH	CYPRESS CRK	IRRG	40	30		68-AC TR, SC, AMEND 11/12/84
3978-000	1	Real	9421000000	N M FITZGERALD JR ESTATE	FLYNN CRK	IRRG	187	63		156.95-AC TR, SC
4008-000	1	Real	9172500000	DOUGLAS B & MARGARET MARSHALL	NUECES RIVER	IRRG	400	200		AMEND 12/15/81 INCR AC-FT, ACRES, CFS
4094-000	1	Real	3905500000	GEORGE S HAWN INTERESTS ET AL	W FRIO RIVER	IRRG	56	28	9	OUT OF 1118 ACRES
4169-000	1	Real	7910000000	ROARING SPRINGS RANCH INC	CAMP WOOD CRK	IRRG	15	10	41	6 RES & REC
4169-000	1	Real	7910000000	ROARING SPRINGS RANCH INC	CAMP WOOD CRK	MUNI	15			
4405-000	1	Real	7760000000	CITY OF CAMP WOOD	UNNAMED TRIB NUECES RIVER	MUNI	1000			
4405-000	1	Real	7760000000	CITY OF CAMP WOOD	UNNAMED TRIB NUECES RIVER	IRRG	83	16		
4413-000	1	Real	8240000000	WILLIAM C SUTTON ET UX	CAMP WOOD CRK	REC			2	
5009-000	1	Real	3830000000	JACKSON L BABB ET AL	W FRIO RIVER	IRRG	60	30		
2653-000	6	Val Verde	4950000000	PHIL B FOSTER	CIENEGAS CRK &/OR THE RIO GRANDE	IRRG	122.25	61.13		AMEND 10/15/91
2653-000	6	Val Verde	4950000000	DAVID B TERK ET AL	CIENEGAS CRK	IRRG	27.75	13.87		AMEND 10/15/91
2654-000	6	Val Verde	4950000000	THURMAN W OWENS	CIENEGAS CRK	IRRG	26	13		RATE SEE 23-2653
2655-000	6	Val Verde	4950000000	JOSE C OVIEDO ET UX	CIENEGAS CRK	IRRG	28	14		RATE SEE 23-2653
2656-000	6	Val Verde	4950000000	RANDOLPH J N & SHARON M ABBEY	CIENEGAS CRK	IRRG	68	43		RATE SEE 23-2653
2657-000	6	Val Verde	4950000000	RONALD J PERSYN ET UX	CIENEGAS CRK	IRRG	150	75		RATE SEE 23-2653
2657-000	6	Val Verde	4950000000	RONALD J. PERSYN, ET UX	CIENEGAS CRK	IRRG	150	68		SEE 23-2653 RATE; AMEND 10/89
2657-000	6	Val Verde	4950000000	RONALD J. PERSYN, ET UX	CIENEGAS CRK	IRRG		89		AMEND 8/2/94
2659-000	6	Val Verde	4950000000	JOHN F QUALIA	CIENEGAS CRK	IRRG	112	56		FOR RATE SEE 23-2653
2660-000	6	Val Verde	4950000000	JOSE A CORTINAS ET AL	CIENEGAS CRK	IRRG	16	5		
2660-000	6	Val Verde	4950000000	LJB ENTERPRISES	CIENEGAS CRK	IRRG	296	99		
2661-000	6	Val Verde	4950000000	BARBARA GULICK RATHKE, ET AL	CIENEGAS CRK	IRRG	120	40	10	

APPENDIX 3A. (Continued) Authorized Surface Water Rights as Extracted from TCEQ's Active Water Rights Master File

Water Right Number	Type	County	River Order Permit	Name	Stream	Use	Amount in Ac-Ft/Yr	Acreage	Res Cap in Ac-Ft	Remarks
2662-000	6	Val Verde	4950000000	CAPITOL AGGREGATES INC	CIENEGAS CRK	MINE	166	17		AMEND 11/2/87
2663-000	6	Val Verde	4950000000	ALFREDO GUTIERREZ JR	CIENEGAS CRK	IRRG	24	8		
2664-000	6	Val Verde	4950000000	SAN FELIPE A MFG & I COMPANY	SAN FELIPE CRK	IRRG	4950	1700		AMEND 12/16/88, 10/31/94
2664-000	6	Val Verde	4950000000	SAN FELIPE A MFG & I COMPANY	SAN FELIPE CRK	IRRG	6		6	IMPOUNDMENT #1
2664-000	6	Val Verde	4950000000	SAN FELIPE A MFG & I COMPANY	SAN FELIPE CRK	IRRG	6		6	IMPOUNDMENT #2
2664-000	6	Val Verde	4950000000	SAN FELIPE A MFG & I COMPANY	SAN FELIPE CRK	INDU	50			AMENDMENT EXP 12/31/96
2665-000	6	Val Verde	4950000000	JOSE OVIEDO JR ET UX	SAN FELIPE CRK	IRRG	60	40		AMENDED 9/13/96
2666-000	6	Val Verde	4950000000	PETRA ABREGO MUNOZ	SAN FELIPE CRK	IRRG	23.56	7.85		
2669-000	6	Val Verde	4950000000	RODOLFO MOTA	SAN FELIPE CRK	IRRG	6	2		
2670-000	6	Val Verde	4950000000	VICTOR D BOLNER	SAN FELIPE CRK	IRRG	6	3		
2672-000	6	Val Verde	4950000000	CITY OF DEL RIO	SAN FELIPE CRK	MUNI	4416			
2672-000	6	Val Verde	4950000000	CITY OF DEL RIO	SAN FELIPE CRK	MUNI	7000			
2811-000	6	Val Verde	4950000000	RIO BRAVO INC	CIENEGAS CRK &/OR THE RIO GRANDE	IRRG	51.08	997.97	47	& REC/DOM, AMEND 1/84,6/91
2811-000	6	Val Verde	4950000000	DAVID B TERK	CIENEGAS CRK	IRRG	114.64	95.38		
2912-000	6	Val Verde	4950000000	MOODY RANCHES INC	SAN FELIPE CRK	IRRG	800	400	10	
3880-000	1	Val Verde	4950000000	SOUTH TEXAS ELECTRIC CO-OP INC	RIO GRANDE	HYDRO	1500000			AMEND 12/14/87. POWER POOL WITH MEDINA.
3880-000	1	Val Verde	4950000000	MEDINA ELECTRIC CO-OP INC	RIO GRANDE	HYDRO				AMEND 12/14/87. POWER POOL WITH S.TX.EL.
5506-000	1	Val Verde	4950000000	DEL RIO, CITY OF	SAN FELIPE CRK	REC			0.19	WATER PARK LANDING POOL

CHAPTER 4
IDENTIFICATION OF WATER NEEDS

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4 IDENTIFICATION OF WATER NEEDS

Chapter 4 provides projections (Table 4-1) of water supply surpluses or deficits by decade based on a comparison of projected water demands by decade for each water-use entity from Chapter 2 with water supplies available to meet those demands from Chapter 3. Entities are then identified that, in any decade within the 50-year planning period, develop a water-supply need (deficit) that is greater than that entity's ability to provide a supply to meet that need. A water-supply deficit may develop for individual water-use entities for numerous reasons including supply availability limits, infrastructure limitations, or legal limits. Table 4-2 provides the WUG's needs / surpluses analyses by category of use. Tables 4-3 and 4-4 provide a similar analysis by Major Water Providers (Del Rio Utilities Commission) and by category of use by the Major Water Provider.

Municipal water supply deficits are identified for Rocksprings, Kerrville, Kerrville South Water, Camp Wood, Del Rio Utilities, Laughlin Air Force Base, and County-Other (rural) in Kerr County. Irrigation shortages are shown in Bandera, Edwards, and Kerr Counties; mining shortages in Edwards, Kerr, and Val Verde Counties; livestock shortages in Bandera, Edwards, and Kerr Counties; and manufacturing shortages in Real County. Water management strategies developed for this *Plan* are intended to meet all projected water supply shortages.

A secondary water needs analysis by all water user groups and by category of use for which conservation or direct reuse water management strategies are recommended is provided in Table 4-5 and 4-6. This secondary water needs analysis calculates the water needs that would remain after assuming all recommended conservation and reuse water management strategies are fully implemented. Table 4-7 provides similar data by Major Water Providers. Del Rio Utilities Commission is listed in these tables as both a WUG and MWP.

Unmet needs resulting from insufficient supplies to meet certain strategies are included in the TWDB tables in the Executive Summary.

Water-supply strategy recommendations are then made in Chapter 5 for those water users that have projected water-supply deficits based on the comparison between demand and supply. In addition, strategies are also developed for specific entities that although they are not projected to have future shortages, they do have anticipated water-supply projects that deserve to be recognized in the *Regional Plan*. A socioeconomic impact of unmet water needs analysis prepared by the Texas Water Development Board is provided in Appendix 6A.

It is important to note that the methodology used to estimate water needs/surpluses for county-other use depicts water supply available to county-other, as a whole. The methodology assumes that all county-other water supply is available to satisfy demand, whereas, in reality, county-other population and water demand are often concentrated in smaller areas of the county such as unincorporated communities, subdivisions and mobile home parks which cannot access water supply available in other areas of the county. The reflected surplus depicted in the tables may or may not be an accurate estimate depending on population densities. Increasing population density, increases water demand by straining available local water-supply resources, though the county-other (as a whole) reflects adequate supply.

Table 4-1. Identified Water (Needs)/Surpluses
(ac-ft/yr)

	2030	2040	2050	2060	2070	2080
Bandera County						
Guadalupe Basin						
County-Other	19	19	18	18	18	18
Livestock	8	8	8	8	8	8
Nueces Basin						
County-Other	176	174	172	169	167	165
Mining	0	0	0	0	0	0
Livestock	(20)	(20)	(20)	(20)	(20)	(20)
Irrigation	14	14	14	14	14	14
San Antonio Basin						
Bandera	149	143	136	129	122	114
Bandera County FWSD #1	97	91	84	76	69	62
County-Other	2,967	2,939	2,901	2,862	2,822	2,781
Mining	1	1	0	0	0	0
Livestock	11	11	11	11	11	11
Irrigation	(957)	(957)	(957)	(957)	(957)	(957)
Edwards County						
Colorado Basin						
Rocksprings	697	719	736	747	757	767
County-Other	21	24	27	28	29	31
Livestock	53	53	53	53	53	53
Irrigation	0	0	0	0	0	0
Nueces Basin						
Rocksprings	(66)	(53)	(42)	(36)	(30)	(23)
County-Other	51	59	63	68	71	74
Mining	(8)	(8)	(8)	(8)	(8)	(8)
Livestock	(53)	(53)	(53)	(53)	(53)	(53)
Irrigation	75	75	75	75	75	75
Rio Grande Basin						
County-Other	10	11	13	13	14	15
Livestock	34	34	34	34	34	34
Irrigation	(15)	(15)	(15)	(15)	(15)	(15)
Kerr County						
Colorado Basin						
County-Other	(79)	(83)	(86)	(91)	(96)	(101)
Livestock	(28)	(28)	(28)	(28)	(28)	(28)
Irrigation	(97)	(97)	(97)	(97)	(97)	(97)

Table 4-1. (continued) Identified Water (Needs)/Surpluses (ac-ft/yr)

	2030	2040	2050	2060	2070	2080
Guadalupe Basin						
Kerrville	(1,445)	(1,780)	(2,032)	(2,435)	(2,842)	(3,231)
Kerrville South Water	(70)	(88)	(103)	(126)	(150)	(173)
County-Other	2,324	2,192	2,088	1,925	1,759	1,601
Manufacturing	70	69	68	67	66	65
Mining	(75)	(75)	(75)	(75)	(75)	(75)
Livestock	15	15	15	15	15	15
Irrigation	682	682	671	655	655	655
Nueces Basin						
County-Other	1	1	1	0	0	0
Livestock	0	0	0	0	0	0
San Antonio Basin						
County-Other	28	26	25	23	21	19
Livestock	(41)	(41)	(41)	(41)	(41)	(41)
Irrigation	(3)	(3)	(3)	(3)	(3)	(3)
Kinney County						
Nueces Basin						
County-Other	3	3	3	3	3	4
Livestock	28	28	28	28	28	28
Irrigation	0	0	0	0	0	0
Rio Grande Basin						
Brackettville	117	146	164	175	186	198
Fort Clark Springs MUD	644	683	708	724	739	755
County-Other	69	73	75	77	78	78
Livestock	10	10	10	10	10	10
Irrigation	1,035	1,035	1,035	1,035	1,035	1,035
Real County						
Colorado Basin						
County-Other	6	6	7	7	7	8
Irrigation	3	3	3	3	3	3
Nueces Basin						
Camp Wood	(147)	(124)	(106)	(92)	(78)	(64)
Leakey	434	456	473	487	500	515
County-Other	319	352	378	398	418	437
Manufacturing	(2)	(2)	(2)	(2)	(2)	(2)
Livestock	0	0	0	0	0	0
Irrigation	1,636	1,636	1,636	1,636	1,636	1,636

Table 4-1. (continued) Identified Water (Needs)/Surpluses (ac-ft/yr)

	2030	2040	2050	2060	2070	2080
Val Verde County						
Rio Grande Basin						
Del Rio Utilities Commission	(5,516)	(5,524)	(5,556)	(5,587)	(5,618)	(5,649)
Laughlin Air Force Base	111	113	113	113	113	113
County-Other	592	568	537	526	514	502
Manufacturing	0	0	0	0	0	0
Mining	2	(6)	(15)	(23)	(30)	(38)
Livestock	0	0	0	0	0	0
Irrigation	143	143	143	143	143	143

Table 4-2. Identified Water (Needs)/Surpluses by Category (ac-ft/yr)

WUG County	WUG Category	WUG Water Supply (Needs) / Surplus 2030	WUG Water Supply (Needs) / Surplus 2040	WUG Water Supply (Needs) / Surplus 2050	WUG Water Supply (Needs) / Surplus 2060	WUG Water Supply (Needs) / Surplus 2070	WUG Water Supply (Needs) / Surplus 2080
Bandera	Municipal	3,408	3,366	3,311	3,254	3,198	3,140
	Mining	1	1	0	0	0	0
	Livestock	(1)	(1)	(1)	(1)	(1)	(1)
	Irrigation	(943)	(943)	(943)	(943)	(943)	(943)
Edwards	Municipal	713	760	797	820	841	864
	Mining	(8)	(8)	(8)	(8)	(8)	(8)
	Livestock	34	34	34	34	34	34
	Irrigation	60	60	60	60	60	60
Kerr	Municipal	759	268	(107)	(704)	(1,308)	(1,885)
	Manufacturing	70	69	68	67	66	65
	Mining	(75)	(75)	(75)	(75)	(75)	(75)
	Livestock	(54)	(54)	(54)	(54)	(54)	(54)
	Irrigation	582	582	571	555	555	555
Kinney	Municipal	833	905	950	979	1,006	1,035
	Livestock	38	38	38	38	38	38
	Irrigation	1,035	1,035	1,035	1,035	1,035	1,035
Real	Municipal	612	690	752	800	847	896
	Manufacturing	(2)	(2)	(2)	(2)	(2)	(2)
	Livestock	0	0	0	0	0	0
	Irrigation	1,639	1,639	1,639	1,639	1,639	1,639
Val Verde	Municipal	(4,813)	(4,843)	(4,906)	(4,948)	(4,991)	(5,034)
	Manufacturing	0	0	0	0	0	0
	Mining	2	(6)	(15)	(23)	(30)	(38)
	Livestock	0	0	0	0	0	0
	Irrigation	143	143	143	143	143	143

Table 4-3. Del Rio Major Water Provider Identified Water (Needs)/Surpluses (ac-ft/yr)

County	Basin	Major Water Provider	Receiving Entity	2030	2040	2050	2060	2070	2080
Val Verde	Rio Grande	Del Rio Utilities	City of Del Rio	(5,516)	(5,524)	(5,556)	(5,587)	(5,618)	(5,649)
			Laughlin AFB	111	113	113	113	113	113
			County-Other	592	568	537	526	514	502

Table 4-4. Del Rio Major Water Provider Identified Water (Needs)/Surpluses by Category (ac-ft/yr)

County	Basin	Major Water Provider	Receiving Entity	2030	2040	2050	2060	2070	2080
Val Verde	Rio Grande	Del Rio Utilities	Municipal	(4,813)	(4,843)	(4,906)	(4,948)	(4,991)	(5,034)
			Manufacturing	0	0	0	0	0	0
			Mining	2	(6)	(15)	(23)	(30)	(38)
			Livestock	0	0	0	0	0	0
			Irrigation	143	143	143	143	143	143

Table 4-5. Second Tier Identified Water Needs by WUG (ac-ft/yr)

	2030	2040	2050	2060	2070	2080
Bandera County						
Guadalupe Basin						
County-Other	0	0	0	0	0	0
Livestock	0	0	0	0	0	0
Nueces Basin						
County-Other	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Livestock	(7)	(7)	(7)	(7)	(7)	(7)
Irrigation	0	0	0	0	0	0
San Antonio Basin						
Bandera	0	0	0	0	0	0
Bandera County FWSD #1	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Livestock	0	0	0	0	0	0
Irrigation	(881)	(881)	(881)	(881)	(881)	(881)
Edwards County						
Colorado Basin						
Rocksprings	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Livestock	0	0	0	0	0	0

Table 4-5. (continued) Second Tier Identified Water Needs by WUG (ac-ft/yr)

	2030	2040	2050	2060	2070	2080
Edwards County						
Colorado Basin						
Irrigation	0	0	0	0	0	0
Nueces Basin						
Rocksprings	(59)	(46)	(35)	(29)	(23)	(16)
County-Other	0	0	0	0	0	0
Mining	(6)	(6)	(6)	(6)	(6)	(6)
Livestock	(2)	(2)	(2)	(2)	(2)	(2)
Irrigation	0	0	0	0	0	0
Rio Grande Basin						
County-Other	0	0	0	0	0	0
Livestock	0	0	0	0	0	0
Irrigation	0	0	0	0	0	0
Kerr County						
Colorado Basin						
County-Other	(79)	(83)	(86)	(91)	(96)	(101)
Livestock	(22)	(22)	(22)	(22)	(22)	(22)
Irrigation	0	0	0	0	0	0
Guadalupe Basin						
Kerrville	(1,403)	(1,738)	(1,990)	(2,393)	(2,800)	(3,189)
Kerrville South Water	(70)	(88)	(103)	(126)	(150)	(173)
County-Other	0	0	0	0	0	0
Manufacturing	0	0	0	0	0	0
Mining	(45)	(45)	(45)	(45)	(45)	(45)
Livestock	0	0	0	0	0	0
Irrigation	0	0	0	0	0	0
Nueces Basin						
County-Other	0	0	0	0	0	0
Livestock	0	0	0	0	0	0
San Antonio Basin						
County-Other	0	0	0	0	0	0
Livestock	(32)	(32)	(32)	(32)	(32)	(32)
Irrigation	0	0	0	0	0	0
Kinney County						
Nueces Basin						
County-Other	0	0	0	0	0	0
Livestock	0	0	0	0	0	0
Irrigation	0	0	0	0	0	0

Table 4-5. (continued) Second Tier Identified Water Needs by WUG (ac-ft/yr)

	2030	2040	2050	2060	2070	2080
Rio Grande Basin						
Brackettville	0	0	0	0	0	0
Fort Clark Springs MUD	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Livestock	0	0	0	0	0	0
Kinney County						
Rio Grande Basin						
Irrigation	0	0	0	0	0	0
Real County						
Colorado Basin						
County-Other	0	0	0	0	0	0
Irrigation	0	0	0	0	0	0
Nueces Basin						
Camp Wood	(146)	(123)	(105)	(91)	(77)	(63)
Leakey	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Manufacturing	(1)	(1)	(1)	(1)	(1)	(1)
Livestock	0	0	0	0	0	0
Irrigation	0	0	0	0	0	0
Val Verde County						
Rio Grande Basin						
Del Rio Utilities Commission	(4,885)	(4,893)	(4,925)	(4,956)	(4,987)	(5,018)
Laughlin Air Force Base	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Manufacturing	0	0	0	0	0	0
Mining	0	0	0	(5)	(11)	(17)
Livestock	0	0	0	0	0	0
Irrigation	0	0	0	0	0	0

Table 4-6. Second Tier Identified Water Needs by Category of Use (ac-ft/yr)

WUG County	WUG Category	WUG Water (Needs) 2030	WUG Water (Needs) 2040	WUG Water (Needs) 2050	WUG Water (Needs) 2060	WUG Water (Needs) 2070	WUG Water (Needs) 2080
Bandera	Municipal	0	0	0	0	0	0
	Mining	0	0	0	0	0	0
	Livestock	(7)	(7)	(7)	(7)	(7)	(7)
	Irrigation	(881)	(881)	(881)	(881)	(881)	(881)
Edwards	Municipal	(59)	(46)	(35)	(29)	(23)	(16)
	Mining	(6)	(6)	(6)	(6)	(6)	(6)
	Livestock	(2)	(2)	(2)	(2)	(2)	(2)
	Irrigation	0	0	0	0	0	0
Kerr	Municipal	(1,552)	(1,909)	(2,179)	(2,610)	(3,046)	(3,463)
	Manufacturing	0	0	0	0	0	0
	Mining	(45)	(45)	(45)	(45)	(45)	(45)
	Livestock	(55)	(55)	(55)	(55)	(55)	(55)
	Irrigation	0	0	0	0	0	0
Kinney	Municipal	0	0	0	0	0	0
	Livestock	0	0	0	0	0	0
	Irrigation	0	0	0	0	0	0
Real	Municipal	(146)	(123)	(105)	(91)	(77)	(63)
	Manufacturing	(1)	(1)	(1)	(1)	(1)	(1)
	Livestock	0	0	0	0	0	0
	Irrigation	0	0	0	0	0	0
Val Verde	Municipal	(4,885)	(4,893)	(4,925)	(4,956)	(4,987)	(5,018)
	Manufacturing	0	0	0	0	0	0
	Mining	0	0	0	(5)	(11)	(17)
	Livestock	0	0	0	0	0	0
	Irrigation	0	0	0	0	0	0

Table 4-7. Second Tier Identified Water Needs by Major Water Provider (ac-ft/yr)

County	Basin	Major Water Provider	2030	2040	2050	2060	2070	2080
Val Verde	Rio Grande	Del Rio Utilities	(4,885)	(4,893)	(4,925)	(4,956)	(4,987)	(5,018)

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CHAPTER 5

WATER MANAGEMENT STRATEGIES AND CONSERVATION RECOMMENDATIONS

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5 WATER MANAGEMENT STRATEGIES AND CONSERVATION RECOMMENDATIONS

The PWPG has identified and evaluated a total of 70 water management strategies for the *2026 Plateau Region Water Plan*. Water management strategies are developed for entities where future water supply needs exist (as required by statute and administrative rules 31 TAC §357.34; 357.35). A need for water is identified when existing water supplies are less than projected water demands for that same WUG within any planning decade. In addition, water management strategies were developed for other entities requesting specific water supply projects, even though these entities did not have a projected water supply shortage.

A water management strategy is a plan to meet an identified water need for additional water by an entity, which can mean increasing the total water supply or maximizing an existing supply, including through reducing demand. When a water management strategy project is implemented, it is intended to develop, deliver, and/or treat additional water-supply volumes, or conserve water for an entity (TWDB-Exhibit C Second Amended General Guidelines-September2023).

The PWPG considered non-trivial flood mitigation benefits during the evaluation of all potentially feasible water management strategies for the *2026 Plan.* Currently, there are no water management strategies identified that could provide flood mitigation benefits. However, the PWPG will continue to consider these very important strategies.

5.1 IDENTIFICATION OF POTENTIALLY FEASIBLE WATER MANAGEMENT STRATEGIES

The first step in developing a list of recommended water management strategies is to take a "big picture" look at possible projects that could reasonably be expected to result in water-supply improvements. As required by TWC §16.053(e)(3), and 31 TAC §357.34(c) the Regional Water Planning Groups shall consider, but not be limited to considering, the following types of water management strategies for all identified water needs:

1. Conservation.
2. Drought management.
3. Reuse.
4. Management of existing water supplies.
5. Conjunctive use.
6. Acquisition of available existing water supplies.
7. Development of new water supplies.
8. Developing regional water supply facilities or providing regional management of water supply facilities.
9. Developing large-scale desalination facilities for seawater or brackish groundwater that serve local or regional brackish groundwater production zones identified and designated under TWC §16.060(b)(5)34.
10. Developing large-scale desalination facilities for marine seawater that serve local or regional entities.
11. Voluntary transfer of water within the region using, but not limited to, contracts, water marketing, regional water banks, sales, leases, options, subordination agreements, and financing agreements
12. Emergency transfer of water under TWC §11.139.
13. Interbasin transfers of surface water.
14. System optimization.
15. Reallocation of reservoir storage to new uses.
16. Enhancements of yields.
17. Improvements to water quality.
18. New surface water supply.
19. New groundwater supply.
20. Brush control.
21. Precipitation enhancement.
22. Aquifer storage and recovery.
23. Cancellation of water rights.
24. Rainwater harvesting.

Other potential projects considered for the initial list included:

- Appropriate strategies from the *2021 Plan*.
- Water-loss audits and line replacement.
- Projects suggested by municipalities through a survey.
- Projects that are currently or have recently applied to the TWDB for funding.

The following process was used by the PWPG to identify *potentially feasible water management strategies*.

Needs Analysis

1. Receive a Needs Analysis Report from the TWDB, which provides a comparison of existing water supplies and projected water demands for each WUG and wholesale water provider (WWP) in the Region. Based on this comparison, the report identifies WUGs and WWPs that are expected to experience needs for additional water supplies within the 50-year time frame of the regional water plan.

Identification and Selection Process

1. Review the potential infeasibility and implementation status identifying:
   - If strategy contemplates permitting and/or construction;
   - If strategy is near-term or necessitates significant time for implementation;
   - If the potential sponsor(s) have taken, or have indicated they will take, affirmative steps towards the strategy's implementation. Affirmative steps may include, but not be limited to:
     a. Spending money on the strategy or project.
     b. Voting to spend money on the strategy or project.
     c. Applying for a federal or state permit for the strategy or project.
2. Review and consider recommended water management strategies adopted by the water planning group for the 2021 Plateau Water Plan.
3. Review and consider any issues identified in the most current TWDB Water Loss Audit Report, including leak detection and supply side analysis.
4. Solicit current water planning information, including specific water management strategies of interest from WUGs and WWPs with identified needs.
5. Review and consider the most recent Water Supply Management, Water Conservation, and/or Drought Contingency Plans, where available, from WUGs and WWPs with identified needs.
6. Consider potentially feasible water management strategies that may include, but are not limited to (Chapter 357 Subchapter C §357.34):
   - Extended use of existing supplies including:
     a. System optimization and conjunctive use of water resources.
     b. Reallocation of reservoir storage to new uses.
     c. Voluntary redistribution of water resources including contracts, water marketing regional water banks, sales, leases, options, subordination agreements, and financing agreements.
     d. Subordination of existing water rights through voluntary agreements.
     e. Enhancement of yields of existing sources.
     f. Improvement of water quality including control of naturally occurring chlorides.
     g. Drought management.

- New supply development including:
    a. Construction and improvement of surface water and groundwater resources.
    b. Brush control.
    c. Precipitation enhancement.
    d. Desalination.
    e. Water supply that could be made available by cancellation of water rights.
    f. Rainwater harvesting.
    g. Aquifer storage and recovery.

- Conservation and drought management measures including demand management.
- Reuse of wastewater.
- Interbasin transfers of surface water.
- Emergency transfers of surface water.

7. Consider other *potentially feasible water management strategies* suggested by planning group members, stakeholders, and the public.
8. Based on the above reviews and considerations, establish a preliminary list of *potentially feasible water management strategies*. At a discussion level, consider the following feasibility concerns for each strategy:
    - Water supply source availability during drought-of-record conditions.
    - Cost/benefit.
    - Water quality.
    - Threats to agriculture and natural resources.
    - Impacts to the environment, other water resources, and basin transfers.
    - Socio-economic impacts.
9. Based on the above discussion level analysis, select a final list of *potentially feasible water management strategies* for further technical evaluation using detailed analysis criteria.

Using the above criteria and process, the PWPG selected the initial potentially feasible water management strategies listed in Table 5-1 for further detailed analysis. All strategy analyses recognize and protect existing water rights, water contracts, and option agreements. As the water management strategy analysis progressed, it became evident that the initial list would require modification of project descriptive names, and the possible addition of new strategies and the elimination or transfer of others. Much time was spent in communication with individual WUGs (municipalities, irrigation districts, etc.) to ensure that the strategies discussion met with their approval. The evaluation and final recommendation of water management strategies are provided in Appendix 5A.

Although these strategy types were considered by the PWPG, not all of them were considered viable options for addressing long-term needs in the region. The PWPG does not consider drought management as a feasible strategy to meet long-term growth in demands or current needs. This strategy is considered a temporary measure aimed at conserving available water supplies during times of drought or emergencies. Drought management is most adequately addressed in the Region through the implementation of local drought contingency plans. The PWPG is supportive of the development and use of these plans during periods of drought or emergency water needs.

Table 5-1. Potentially Feasible Water Management Strategies

County	Water User Group	Strategy Source Basin	Water Management Strategy
Bandera	City of Bandera	San Antonio	Reuse treated wastewater effluent for irrigation use
			Promote, design & install rainwater harvesting systems
			Additional Lower Trinity well and lay necessary pipeline
			Additional Middle Trinity wells within city infrastructure
			Surface water acquisition, treatment, and ASR
	*Bandera County FWSD#1	San Antonio	Conservation
			New strategy - Additional groundwater well
	*Bandera County Other (Bandera River Ranch #1)	San Antonio	Water loss audit and main-line repair
	*Bandera County Other (Lake Medina Shores)	San Antonio	Conservation
			Additional groundwater wells
	*Bandera County Other (Medina WSC)	San Antonio	Conservation
			Additional groundwater well for the Town of Medina
	Bandera County Other	San Antonio	Drought management (BCRAGD)
			Additional groundwater well for Pebble Beach Subdivision
			Additional groundwater wells to provide emergency supply to VFD
			Water loss audit and main-line repair for Enchanted River Estates
			**Vegetative Management
		Nueces	Drought management (BCRAGD)
	*Bandera County Irrigation	San Antonio	Conservation
			Additional groundwater wells
	*Bandera County Livestock	*Guadalupe	Conservation
			Additional groundwater well
		*Nueces	Conservation
			Additional groundwater well
Edwards	*City of Rocksprings	*Nueces	Conservation
			Additional groundwater well
	Edwards County Other (Barksdale WSC)	Nueces	Additional groundwater well in the Nueces River Alluvium
	Edwards County Other	Nueces	**Vegetative Management
	*Edwards County Mining	*Nueces	Conservation
			Additional groundwater wells
		*Colorado	Conservation
			Additional groundwater wells
		*Rio Grande	Conservation
			Additional groundwater wells
Kerr	*City of Kerrville	Guadalupe	Increase wastewater reuse
			Water loss audit and main-line repair
			Explore and develop potable reuse

Table 5-1. (continued) Potentially Feasible Water Management Strategies

County	Water User Group	Strategy Source Basin	Water Management Strategy
Kerr	*City of Kerrville	Guadalupe	Explore and develop new Ellenburger Aquifer well supply
			Purchase Guadalupe River water rights
			Increased water treatment and ASR capacity
Kerr	Kerr County Other *(Center Point)	Guadalupe	*** EKCRWSP
	Kerr County Other (Center Point North WS)	Guadalupe	*** EKCRWSP
	Kerr County Other *(Center Point Taylor	Guadalupe	*** EKCRWSP
	Kerr County Other (Hills and Dales Estate)	Guadalupe	*** EKCRWSP
	Kerr County Other (Nickerson Farm WS)	Guadalupe	*** EKCRWSP
	Kerr County Other (Oak Forest South Water)	Guadalupe	*** EKCRWSP
	Kerr County Other (Park Place Subdivision)	Guadalupe	*** EKCRWSP
	Kerr County Other (Pecan Valley)	Guadalupe	*** EKCRWSP
	Kerr County Other (Rustic Hills Water)	Guadalupe	*** EKCRWSP
	Kerr County Other (Verde Park Estates)	Guadalupe	Water loss audit and main-line repair for Verde Park Estates
			*** EKCRWSP
	Kerr County Other (Westwood WS)	Guadalupe	*** EKCRWSP
	*Kerr County Other	*Nueces	Conservation: Public information and education - Water shortage met with Guadalupe Basin strategies
		Guadalupe	Water loss audit and main-line repair for Community Water Group WSC
			**Vegetative management - UGRA
	*Kerr County Irrigation	San Antonio	Conservation
			Additional groundwater well
	*Kerr County Livestock	*Colorado	Conservation
			Additional groundwater wells
		*Guadalupe	Conservation
			Additional groundwater wells
		*San Antonio	Conservation
			Additional groundwater well
		*Nueces	Conservation
			Additional groundwater well
	*Kerr County Mining	Colorado	Conservation
			Additional groundwater well
Kinney	City of Brackettville	Rio Grande	Increase supply to Spofford with new water line
			Increase storage facility
	Fort Clark Springs MUD	Rio Grande	Water loss audit and main-line repair

Table 5-1. (continued) Potentially Feasible Water Management Strategies

County	Water User Group	Strategy Source Basin	Water Management Strategy
Kinney	Fort Clark Springs MUD	Rio Grande	Increase storage facility
	Kinney County Other	Rio Grande	**Vegetative Management
		Nueces	**Vegetative Management
Real	*City of Camp Wood	Nueces	Conservation: Public information and education - Water shortage met with Guadalupe Basin strategies
			Additional groundwater wells
	*City of Leakey	Nueces	Conservation
			Additional groundwater well
			Develop interconnections between wells within the City
	Real County Other	Nueces	Water loss audit and main-line repair for Real WSC
			**Vegetative Management
			Additional groundwater well for Oakmont Saddle WSC
Val Verde	City of Del Rio	Rio Grande	Water loss audit and main-line repair
			Additional groundwater well
			Water treatment plant expansion
			Develop a wastewater reuse program
	Val Verde County Other	Rio Grande	Water loss audit and main-line repair for Val Verde County WCID Comstock
			Water loss audit and main-line repair for San Pedro Canyon Subdivision (Upper)
			Water loss audit and main-line repair for Tierra Del Lago
			**Vegetative Management
	*Val Verde County Mining	Rio Grande	Conservation
			Additional groundwater well
* WUG with a supply need.			
** Vegetative Management has an availability of zero.			

*** Eastern Kerr County Regional Water Supply Project Strategies		
East Kerr County Regional Water Supply Project	Guadalupe	UGRA acquisition of surface water rights
		KCCC acquisition of surface water rights
		Construction of an off-channel surface water storage
		Construction of surface water treatment facilities and main distribution transmission lines
		Construction of an ASR facility
		Construction of a wellfield for dense rural areas
		Construction of a brackish groundwater desalination facility
		Construction of an Ellenburger Aquifer water supply source
		Conservation

5.2 EVALUATION AND RECOMMENDATION OF WATER MANAGEMENT STRATEGIES

5.2.1 Strategy Evaluation Procedure

The strategy evaluation procedure is designed to provide a side-by-side comparison such that all strategies can be assessed based on the same quantifiable factors as shown in Tables 5-2, 5-3 and 5-4. An explanation of the qualitative and quantifiable rankings is provided in Appendix 5B. All strategy analyses recognize and protect existing water rights, water contracts, and option agreements. For planning purposes, it is assumed that all strategies experience a two percent water loss over the life of the strategy project. Specific factors considered in each Table were:

<u>Table 5-2</u>

- Quantity of new water supply produced
- Chemical quality
- Reliability of supply
- Impacts to water, agricultural, and natural resources

<u>Table 5-3</u>

- Financial cost (total capital cost, annual cost, and cost per acre-foot)

<u>Table 5-4</u>

- Environmental impacts:
    - Environmental water needs.
    - Wildlife habitat.
    - Cultural resources.
    - Environmental water quality.
    - Inflows to bays and estuaries.

Cost evaluations for all strategies include capital cost, debt service, and annual operations and maintenance (O&M) expenses. Capital costs are estimated based on September 2023 US dollars. Capital costs consider construction costs, engineering and feasibility studies, legal assistance, financing, bond counsel and contingencies, permitting and mitigation, land purchase not associated with mitigation, easement costs, and purchase of water rights. The length of debt service is 20 years unless otherwise stated. An annual unit cost is also calculated based on the O&M cost per ac-ft of water supplied. The TWDB Unified Costing Tool was used for all strategy evaluations except for when specific municipalities provided engineering design studies that included cost estimates.

Water quality is recognized as an important component in this 50-year water plan. To ensure that this *Plan* fully considers water quality, the Federal Clean Water Act and the State Clean Rivers Program were reviewed and considered when developing water management strategies and water quality impacts. Development of water management strategies were also guided by the principal that the designated water quality and related water uses described in the WQMPs of TCEQ and the TSSWCB were improved or maintained. TCEQ's WQMP is tied to the State's water quality assessments that identify and direct planning for implementation measures that control and/or prevent priority water quality problems.

Elements contained in the WQMP include effluent limitations of wastewater facilities, total maximum daily loads (TMDLs), nonpoint source management controls, identification of designated management agencies, and ground water and source water protection planning. TSSWCB's WQMP is a site-specific plan developed through and approved by soil and water conservation districts for agricultural or silvicultural lands. The plan includes appropriate land treatment practices, production practices, management measures, and technologies.

The PWPG relied on Management Supply Factors calculated and supplied by TWDB in the consideration of water-supply needs to be generated in the development of water management strategies. A Management Supply Factor is the combined total of existing and future supply divided by the total projected demand and may be used to consider uncertainties in population, water supply and demand, and other impactful conditions. Management Supply Factors are shown for all WUGs in a table provided in the Executive Summary.

The development of water management strategies is intended to assist entities with their future water supply needs based on drought-of-record conditions. Recommendations of the DPC for the 2026 Plans consisted of three new recommendations: (1) The regional water plans and State water plan shall serve as water supply plans under drought of record conditions; (2) DCP encourages regional water planning groups to incorporate projected future reservoir evaporation rates in their assessments of future surface water availability; and (3) DCP encourages regional water planning groups to identify in their plans utilities within their boundaries that reported having less than 180 days of available water supply to the TCEQ. Also, WUGs conservation and drought management plans (see Chapters 6 and 7) were reviewed to identify potential strategies that are currently under consideration by the entity.

Several strategies are considered integral or interconnected to the new supply goal for a specified WUG or cooperation between WUGs. Strategy J-34 lists several projects that may serve the small communities and rural population of eastern Kerr County. These strategies are developed independently, and their interactions do not impact the water supply availability and yield associated with each individual strategy.

5.2.2 Emphasis on Conservation and Reuse

In terms of recommending strategies to meet future water needs, it is most practical and often most economical to consider potential conservation and reuse projects. Conservation generally includes best management practices that are undertaking either voluntarily by water customers or as mandated by water suppliers. Existing WUG conservation and drought management plans were reviewed, and conservation strategies selected for this *Plan* were often identified from these plans. Water conservation is discussed in further detail in Section 5.3 of this Chapter. The following paragraph is assigned to all Public Conservation Education strategies:

> ***"Public information programs, even though they may not be directly related to any equipment or operational change, can result in both short- and long-term water savings. Behavioral changes by customers will only occur if a reasonable, yet compelling cause can be presented with sufficient frequency to be recognized and absorbed by the customers. There are many resources that can be consulted to provide insight into implanting effective information programs. Like any marketing or public information program, to be effective, water conservation public information should be planned out and implemented in a consistent and continual manner. A more detailed description of conservation best management practices that***

might be encouraged is available in TWDB Report 362, Water Conservation Best Management Practices Guide. An updated version of this report is available on the TWDB's website and is titled Understanding Best Management Practices."

5.2.3 Water Loss Audit Strategies

In 2003, the 78th Texas Legislature, enacted House Bill 3338 to help conserve the State's water resources by reducing water loss occurring in the systems of drinking water utilities. This statute requires that retail public utilities providing water within Texas file a standardized water audit once every five years with the TWDB. See Section 1.6 in Chapter 1 of this Plan for a more detailed discussion. Entities that meet the key performance indicators discussed in Section 1.6 of Chapter 1 were selected to receive a water loss audit and line replacement strategy.

Across the Plateau Region, it is estimated that around 696 ac-ft of supply could be obtained through a water loss audits and leak repairs program in 2030. The reliability of this supply is low due to uncertainty associated with estimated savings and the extent to which this strategy relies on individual utilities to adopt a water loss audits and leak repairs program, which can be costly and time intensive, especially for smaller users. Due to the relatively high costs of implementing this strategy, especially for smaller or rural WUGs, this strategy may not be feasible.

System water audits and water loss programs are effective methods of accounting for all water usage by a public utility within its service area. The structured approach of a water audit allows a utility to reliably track water uses and provide the information to address unnecessary water and revenue losses. The resulting information from a water audit will be valuable in setting performance indicators and in establishing goals and priorities for cost-effectively reducing water losses. By adopting this Best Management Practice (BMP), utilities will more frequently implement water auditing and loss reduction techniques than required by HB 3338. The reliability of this water savings is contingent on the aggressive implementation of this BMP and the public's willingness to do their part.

5.2.4 Recommended Water Management Strategies

The strategy evaluation procedure, as described in Section 5.2.1 above, was followed on each of the potentially feasible strategies selected in Table 5-1. Some potential strategies were determined to not meet guideline standards and were thus eliminated. Also, several new strategies were introduced and were subsequently evaluated. Upon completion of the evaluation phase, the PWPG reviewed evaluation criteria and selected the final water management strategies listed in Table 5-2.

Seawater desalination, a major alternative water management solution for the coastal portion of Texas, was not selected for consideration in the Plateau Water Planning Region as the nearest direct point of origin for a seawater source is more than 150 miles from the easternmost border of the Plateau Region and is thus not rationally economically feasible.

Third-party social and economic impacts resulting from voluntary redistributions of water, including impacts of moving water from rural and agricultural areas were considered; however, no strategies were recommended that resulted in moving water from such areas.

Table 5-2 provides a comparative listing of all the recommended water management strategies that the PWPG subsequently evaluated for inclusion in the *2026 Plateau Region Water Plan*. Table 5-3 provides a breakdown of the cost estimate for each strategy. Where applicable, capital costs, based on September 2023 US dollars, include the following:

- Construction, engineering and feasibility studies, legal assistance, financing, bond council, and contingencies;
- Environmental and archaeology studies and mitigation;
- Land acquisition and surveying; and
- Interest during construction

Table 5-4 shows the potential impacts on the environment of enacting each strategy. Strategy evaluations are presented in Appendix 5A. The total capital cost for development of all water management strategies is $510,350,573. Appendix 5B provides a matrix procedure for measuring the quantitative and qualitative potential for each water management strategy. Appendix 5C provides the Uniform Costing Model (UCM) automated cost output reports for each water management strategy with a capital cost.

Alternate water management strategies are projects that are not part of the package of Recommended strategies but can be substituted for any Recommended strategy that is later determined to be non-viable. Alternate water management strategies are evaluated in the same way as Recommended strategies based on criteria specified in [31 TAC §357.7(a) (7-9, 12)] and are tabulated along with “Recommended” strategies in Tables 5-2, 5-3 and 5-4. Upon conclusion of a thorough evaluation process, the Plateau Water Planning Group identified five Alternate water management strategies.

5.2.5 Assessment of ASR Potential

Texas Water Code §16.053(e)(10) requires that “if a RWPA has significant identified water needs, the RWPG shall provide a specific assessment of the potential for ASR projects to meet those needs.” The PWPG considers municipal utilities as the only WUGs in the Plateau Region that would have the resources available to initiate an ASR project; and that the threshold for “significant” identified water needs are defined by the PWPG as any municipal utility with greater than 800 ac-ft per year need over the 50-year planning horizon. This horizon only occurs with the City of Del Rio. All other municipal water needs are at a far less significant level. However, the PWPG has recommended ASR water management strategies for the Cities of Bandera and Kerrville, and the Eastern Kerr County Regional Project.

An assessment of ASR potential for Del Rio Utilities considers both source-supply availability and hydrologic capability of the underlying rock formations to perform the necessary storage function of the ASR process. Del Rio Utilities is primarily reliant on its water supply from San Felipe Creek, a tributary of the Rio Grande. The Utility captures its full permitted supply at San Felipe Springs, the principal headwaters of the Creek. Without acquiring additional water rights, the Utility is limited to its current supply availability. The Utility does not have access to water available in nearby Amistad Reservoir on the Rio Grande.

The hydrogeologic nature of the underlying rock units of the Edwards Limestone is only partially understood in the Del Rio area. The upper portion of the formation is highly karstic resulting in the extensive flow paths leading to San Felipe Springs. An ASR reservoir would not likely be feasible in this upper horizon as stored water would not likely remain in place. Lower aquifer reservoirs have not adequately been tested for their ability to store and release injected water. Below the Edwards, the Trinity is likely brackish and probably far less permeable. Depth and reservoir capacity may thus limit the Trinity for its ASR function.

The PWPG considers that there is currently insufficient justification for designating an ASR water management strategy option for Del Rio Utilities in this 2026 Plan. However, the PWPG feels that ASR for the Del Rio area should remain as a research topic worthy of future consideration.

5.2.6 Unmet Needs

Sufficient water management strategy supplies are recommended to meet the identified projected needs of all WUGs in the Region except for Bandera County Irrigation, Edwards County Livestock, and Real County Manufacturing.

	WUG Unmet Needs (ac-ft per Year)					
Water User Group	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
Bandera County Irrigation	(806)	(806)	(806)	(806)	(806)	(806)
Edwards County Livestock	(2)	(2)	(2)	(2)	(2)	(2)
Real County Manufacturing	(1)	(1)	(1)	(1)	(1)	(1)

5.2.7 Unqualified Strategies

The TWDB requires that water management strategies listed in regional water plans develop "new" water supplies to be applicable for SWIFT funding. Projects that involve items such as replacing and/or repairing old infrastructure, and wastewater collection and treatment do not qualify. However, the TWDB offers many other types of financing options. Additional details pertaining to the different types of grants and loans offered can be accessed on the TWDB's Financial Assistance webpage.

5.2.8 Vegetative Management and Land Stewardship

Reduced rainfall during drought-of-record conditions certainly reduces aquifer recharge potential. However, some rainfall (and thus recharge) still does occur. Research studies have documented potential recharge impacts (see discussion below) resulting from vegetative management. Chapter 7, Section 7.1.1 defines drought-of-record conditions pertaining to rainfall in the Plateau Region as being an average of 20 percent (five inch) reduction in rainfall per year during the 1950's drought and an average 40 percent (10 inch) reduction during more current years. Assuming the worst-case scenario of 40 percent reduction in precipitation will likewise result in 40 percent reduction in average recharge potential, the PWPG strongly believes that strategies J-13, J-24, J-39, J-51, J-52, J-60, and J-68 produce a reliable amount of supply even during drought conditions. The PWPG recognizes that the concept of properly managing rural range lands is essential in maintaining natural spring flows in the headwaters of surface streams and rivers.

Several invasive species have been recognized in the Plateau Region, as well as elsewhere in the State, that have a negative impact on surface water flow in springs, creeks and rivers, as well as recharge to underlying aquifers. Species of major concern are Giant River Cane (*Arundo donax*) and Elephant Ears (*Colocasia esculenta*) in watersheds, and the encroachment of woody species such as Ashe-juniper and Mesquite. The PWPG has selected vegetative management as an appropriate water management strategy for each river basin within each county in the Plateau Region.

Vegetative management of Ashe Juniper, also commonly known as “cedar” has become a significant source of discussion and debate as to its impact on water resources on the Edwards Plateau. Ashe Juniper is native to central Texas and was initially controlled through both man-made and natural fires and through foraging. As these events were reduced, cedar returned and has been expanding in the Region. Eradication methods have included controlled burns, use of heavy equipment to pull the plant up by its roots, mechanical cutting and chemical methods. There has been a great deal of debate regarding the impact on water resources by cedar with various groups calculating how much water cedar takes away from both groundwater and surface water sources. In a 2003, report done by A.A. McCole of the University of Texas Geology Department, it was noted that “in late summer and winter the Ashe Juniper obtains approximately between 72 percent and 100 percent of its water from groundwater. In contrast, during the wet periods of the year, spring and fall, mass balance calculations indicate that between 45 percent and 100 percent of Ashe Juniper's water is derived from soil water. This seasonal shift indicates the presence of Ashe Juniper can appreciably reduce groundwater resources both by lateral roots intercepting potential recharge during the wet season and direct uptake of groundwater by deep roots during the dry season. Ashe Juniper will directly compete with grasses for soil water during the wet season, limiting herbaceous productivity.”

In 2010, the USGS published a study, “Effects of Brush Management on the Hydrologic Budget and Water Quality in and Adjacent to Honey Creek State Park Natural Area, Comal County, Texas 2001-2010.” The results of this study indicated that brush eradication did not increase runoff to streams but did suggest that clearing brush can result in more infiltration. The study found that before clearing potential groundwater recharge was 17 percent of the total water budget but increased to 24 percent after clearing. The study showed that prior to clearing a rainfall event produced a potential recharge of 5.91 inches of the rain that fell and after clearing, it increased to 7.09 inches; for a difference of 1.18 inches. In terms of actual water, the extra 1.18 inches amounts to approximately 32,042 gallons per acre. Thus, to obtain one acre foot of water, 10 acres will need to be cleared to gain an additional acre foot of water as infiltration. From these and other studies, brush eradication can have a positive impact on groundwater recharge and a limited impact on surface water runoff. However, with increased groundwater recharge it is reasonable to assume that a portion of this groundwater would percolate down to aquifers as well as provide base flow to surface water via springs.

Brush management is a difficult issue to deal with on a planning level since much of the work that needs to be done is on private property with landowners having varied interests. From literature on the subject many authors note that brush management includes both removing the brush, but also providing land management through replacement with other native species that will prevent erosion and hold moisture. However, as a strategy brush management does show potential for enhancing ground water supplies and subsequent base flow to surface water bodies.

Vegetative management of Giant River Cane (*Arundo donax*) has become a significant problem throughout the Plateau Region. The problems with the Giant Cane are a direct result of its incredible growth potential. Individual shoots can grow upwards of four inches per day and a mature stand, or River Cane, can be approximately 30 feet tall. To support these high growth rates the plant requires significant amounts of water. When compared to native species, *Arundo donax* requires three times as much water at a minimum. USDA scientists have calculated that each acre of *Arundo donax* requires approximately 4.37-acre feet of water to support proper growth. Thus, 1,000 acres of *Arundo donax* will consume approximately 4,370-acre feet of water per year.

The eradication methods identified to control the *Arundo donax* are mechanical, chemical, and biological. Additionally, any combination of these three treatment protocols can be an effective treatment option. Mechanical control involves removing all portions of the living plant. Due to the plant's high silicon count, the plant is very flammable and highly susceptible to burning. This approach is not recommended as the burning does not affect the root structure.

Chemical control has proven to be the most effective, which uses glyphosate. Glyphosate interferes with the plant's synthesis of nutrients. Biologic control seems to hold promise for eradication. The USDA has been experimenting with using the asexual Arundo Wasp and has received permits to use this wasp in the eradication efforts. Due to the *Arundo donax* being highly invasive, the Texas Legislature passed legislation making it illegal to sell or distribute *Arundo donax* without a permit from the Texas Department of Agriculture.

An HDR consultant memo to the Brazos G Regional Water Plan (2014) provides projected water supply benefits from feasibility studies (Table 2). According to the memo, the increase in water yield referenced is an increase in the average annual runoff from the treated watershed.

Table 5-2. Summary of Recommended and Alternate Water Management Strategy Evaluation

County	Water User Group	Strategy Source Basin	Strategy	Source	Strategy ID	Strategy Supply (ac-ft Per Year)						Total Capital Cost	Quantity [a]	Quality [b]	Reliability [c]	Strategy Impacts [d]		
						2030	2040	2050	2060	2070	2080		(1-3)	(1-3)	(1-3)	Water Resources (1-5)	Agricultural Resources (1-5)	Natural Resources (1-5)
Bandera	City of Bandera	San Antonio	Water loss audit and main-line repair	Demand Reduction	J-1	5	5	5	5	5	5	$5,327,000	3	n/a	n/a	2	2	2
			Reuse treated wastewater effluent for irrigation of public spaces	Direct Non-Potable Reuse	J-2	0	310	310	310	310	310	$2,117,000	n/a	3	1	1	2	2
			Promote, design & install rainwater harvesting systems on public buildings	Rainwater Harvesting | Demand Reduction	J-3	0	1	1	1	1	1	$83,000	n/a	3	2	1	2	1
			Additional Lower Trinity well and lay necessary pipeline **ALTERNATE**	Lower Trinity Aquifer	J-4	0	403	403	403	403	403	$7,067,000	n/a	1	1	4	2	2
			Additional Middle Trinity wells within City water infrastructure area	Middle Trinity Aquifer	J-5	161	161	161	161	161	161	$1,115,000	n/a	1	1	3	2	3
			Surface water acquisition, treatment and ASR	Trinity Aquifer ASR	J-6	0	1,500	1,500	1,500	1,500	1,500	$50,501,000	n/a	2	2	3	2	2
	Bandera County FWSD #1	San Antonio	Public conservation education	Demand Reduction	J-7	4	4	4	4	4	4	$5,342	3	n/a	n/a	n/a	n/a	n/a
			Additional groundwater well	Lower Trinity Aquifer	J-8	100	100	100	100	100	100	$1,562,000	1	1	1	3	2	3
	Bandera County-Other (Bridlegate Subdivision)	San Antonio	Water loss audit and main-line repair	Demand Reduction	J-9	1	1	1	1	1	1	$2,130,000	3	n/a	n/a	2	2	2
	Bandera County-Other (Flying L Ranch PUD)	San Antonio	Water loss audit and main-line repair	Demand Reduction	J-10	2	2	2	2	2	2	$1,065,000	3	n/a	n/a	2	2	2
	Bandera County-Other (Medina WSC)	San Antonio	Additional groundwater well	Lower Trinity Aquifer	J-11	55	55	55	55	55	55	$2,129,000	1	1	1	3	2	3
	Bandera County-Other (BCRAGD)	San Antonio	Drought management	Demand Reduction	J-12	441	491	516	525	533	537	$0	n/a	n/a	n/a	2	2	2
	***Bandera County-Other	San Antonio	Vegetative Management	Demand Reduction	J-13	1,388	1,388	1,388	1,388	1,388	1,388	$0	3	n/a	n/a	2	2	2
	Bandera County-Other (Volunteer Fire Dept.)	San Antonio	Additional groundwater wells to provide emergency supply **ALTERNATE**	Trinity Aquifer	J-14	189	189	189	189	189	189	$7,527,000	n/a	1	2	3	2	3
	Bandera County-Other (BCRAGD)	Nueces	Drought management	Demand Reduction	J-15	23	26	27	28	28	28	$0	n/a	n/a	n/a	2	2	2
	**Bandera County Irrigation	San Antonio	Irrigation scheduling	Demand Reduction	J-16	76	76	76	76	76	76	$0	3	n/a	n/a	2	2	2
			Additional groundwater wells	Trinity Aquifer	J-17	75	75	75	75	75	75	$399,000	1	3	1	2	2	3
	*Bandera County Livestock	Nueces	Livestock conservation	Demand Reduction	J-18	13	13	13	13	13	13	$0	3	n/a	n/a	2	2	2
			Additional groundwater wells	Middle Trinity Aquifer	J-19	8	8	8	8	8	8	$671,000	1	1	1	3	2	3
Edwards	City of Rocksprings	Nueces	Public conservation education	Demand Reduction	J-20	2	2	2	2	2	2	$5,555	n/a	n/a	n/a	n/a	n/a	n/a
			Water loss audit and main-line repair	Demand Reduction	J-21	5	5	5	5	5	5	$2,130,000	3	n/a	n/a	2	2	2
			Additional groundwater wells	Edwards-Trinity (Plateau) Aquifer	J-22	121	121	121	121	121	121	$1,020,000	n/a	1	1	2	2	3
	Edwards County-Other (Barksdale WSC)	Nueces	Additional well in the Nueces River Alluvium Aquifer and RO wellhead treatment	Nueces River Alluvium	J-23	54	54	54	54	54	54	$317,000	n/a	1	2	3	2	3
	***Edwards County-Other	Nueces	Vegetative Management	Demand Reduction	J-24	87	87	87	87	87	87	$0	3	n/a	n/a	2	2	2
	*Edwards County Irrigation	Rio Grande	Irrigation Scheduling	Demand Reduction	J-25	3,806	3,806	3,806	3,806	3,806	3,806	$0	3	n/a	n/a	2	2	2
	**Edwards County Livestock	Nueces	Livestock conservation	Demand Reduction	J-26	51	51	51	51	51	51	$0	3	n/a	n/a	2	2	2
	*Edwards County Mining	Nueces	Mining Conservation	Demand Reduction	J-27	2	2	2	2	2	2	$0	3	n/a	n/a	2	2	2
			Additional groundwater well	Edwards-Trinity (Plateau) Aquifer	J-28	16	16	16	16	16	16	$154,000	1	1	1	3	2	3

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Table 5-2. (continued) Summary of Recommended and Alternate Water Management Strategy Evaluation

County	Water User Group	Strategy Source Basin	Strategy	Source	Strategy ID	Strategy Supply (ac-ft Per Year)						Total Capital Cost	Quantity [a]	Quality [b]	Reliability [c]	Strategy Impacts [d]		
						2030	2040	2050	2060	2070	2080		(1-3)	(1-3)	(1-3)	Water Resources (1-5)	Agricultural Resources (1-5)	Natural Resources (1-5)
Kerr	*City of Kerrville	Guadalupe	Increase wastewater reuse	Treated wastewater reuse	J-29	2,500	2,500	2,500	2,500	2,500	2,500	$23,355,000	3	3	1	1	2	2
			Water loss audit and main-line repair	Conservation	J-30	42	42	42	42	42	42	$28,757,000	3	n/a	n/a	2	2	2
			Additional groundwater well	Ellenburger-San Saba Aquifer	J-31	1,156	1,156	1,156	1,156	1,156	1,156	$38,542,000	1	1	1	2	2	2
			Increased water treatment and ASR capacity	Trinity Aquifer ASR	J-32	0	3,360	3,360	3,360	3,360	3,360	$21,621,000	1	2	2	2	2	2
	*Kerrville South Water	Guadalupe	Additional groundwater wells	Lower Trinity Aquifer	J-33	200	200	200	200	200	200	$2,209,000	1	1	1	3	2	3
	Kerr County-Other (Eastern Kerr County Regional Water Supply Project)	Guadalupe	Project 1. Construction of an Ellenburger Aquifer water supply well	Ellenburger-San Saba Aquifer	J-34	0	108	108	108	108	108	$906,000	1	1	1	2	2	2
			Project 2. Construction of off-channel surface water storage	Guadalupe River		0	1,121	1,121	1,121	1,121	1,121	$39,053,000	n/a	n/a	n/a	2	2	1
			Project 2. Construction of surface water treatment facilities and transmission lines	Guadalupe River								$48,626,000	n/a	n/a	n/a	2	2	2
			Project 3. Construction of ASR facility	Trinity Aquifer		0	1,124	1,124	1,124	1,124	1,124	$1,881,000	n/a	n/a	n/a	2	2	2
			Project 4. Construction of Trinity Aquifer wellfield for dense, rural areas	Trinity Aquifer		0	860	860	860	860	860	$13,067,000	n/a	n/a	n/a	4	2	2
			Project 4. Construction of desalination plant	Trinity Aquifer								$52,888,000	n/a	n/a	n/a	n/a	n/a	n/a
	Kerr County-Other (Center Point)	Guadalupe	Purchase water from EKCRWSP	Guadalupe River and Trinity Aquifer	J-35	0	11	11	11	11	11	$0	1	1	1	n/a	n/a	n/a
	Kerr County-Other (Center Point Taylor System)	Guadalupe	Purchase water from EKCRWSP	Guadalupe River and Trinity Aquifer	J-36	0	43	43	43	43	43	$0	1	1	1	n/a	n/a	n/a
	Kerr County-Other (Community Water Group WSC)	Nueces	Water loss audit and main-line repair	Demand Reduction	J-37	1	1	1	1	1	1	$1,065,000	3	n/a	n/a	2	2	2
	*Kerr County-Other	Colorado	Purchase water from EKCRWSP	Guadalupe River and Trinity Aquifer	J-38	102	102	102	102	102	102	$0	1	1	1	n/a	n/a	n/a
	***Kerr County-Other	Guadalupe	Vegetative Management	Demand Reduction	J-39	131	131	131	131	131	131	$0	3	n/a	n/a	2	2	2
	*Kerr County Irrigation	Colorado	Irrigation scheduling	Demand Reduction	J-40	1,941	1,941	1,941	1,941	1,941	1,941	$0	3	n/a	n/a	2	2	2
	*Kerr County Irrigation	San Antonio	Irrigation scheduling	Demand Reduction	J-41	1,941	1,941	1,941	1,941	1,941	1,941	$0	3	n/a	n/a	2	2	2
	*Kerr County Livestock	Colorado	Livestock conservation	Demand Reduction	J-42	6	6	6	6	6	6	$0	3	n/a	n/a	2	2	2
			Additional groundwater wells **ALTERNATE**	Trinity Aquifer	J-43	24	24	24	24	24	24	$318,000	1	3	1	3	2	3
	*Kerr County Livestock	San Antonio	Livestock conservation	Demand Reduction	J-44	9	9	9	9	9	9	$0	3	n/a	n/a	2	2	2
			Additional groundwater wells **ALTERNATE**	Trinity Aquifer	J-45	54	54	54	54	54	54	$255,000	1	3	1	3	2	3
	*Kerr County Mining	Guadalupe	Mining Conservation	Demand Reduction	J-46	30	30	30	30	30	30	$0	3	n/a	n/a	2	2	2
			Additional groundwater wells **ALTERNATE**	Edwards-Trinity (Plateau) Aquifer	J-47	48	48	48	48	48	48	$360,000	1	1	1	3	2	3
Kinney	City of Brackettville	Rio Grande	Increase supply to Spofford with new water line	Edwards-Trinity (Plateau) Aquifer	J-48	0	3	3	3	3	3	$13,196,000	n/a	1	1	2	2	2
			Increase storage facility	Edwards-Trinity (Plateau) Aquifer	J-49	0	3	3	3	3	3	$1,438,000	n/a	n/a	n/a	n/a	2	2
	Fort Clark Springs MUD	Rio Grande	Increase storage facility	Edwards-Trinity (Plateau) Aquifer	J-50	0	620	620	620	620	620	$2,499,000	n/a	n/a	n/a	n/a	2	2
	Kinney County Other	Nueces	Vegetative Management	Demand Reduction	J-51	87	87	87	87	87	87	$0	3	n/a	n/a	2	2	2
	Kinney County Other	Rio Grande	Vegetative Management	Demand Reduction	J-52	87	87	87	87	87	87	$0	3	n/a	n/a	2	2	2

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Table 5-2. (continued) Summary of Recommended and Alternate Water Management Strategy Evaluation

County	Water User Group	Strategy Source Basin	Strategy	Source	Strategy ID	Strategy Supply (ac-ft Per Year)						Total Capital Cost	Quantity [a]	Quality [b]	Reliability [c]	Strategy Impacts [d]		
						2030	2040	2050	2060	2070	2080		(1-3)	(1-3)	(1-3)	Water Resources (1-5)	Agricultural Resources (1-5)	Natural Resources (1-5)
Real	*City of Camp Wood	Nueces	Public conservation education	Demand Reduction	J-53	1	1	1	1	1	1	$4,697	3	n/a	n/a	n/a	n/a	n/a
			Additional groundwater wells	Edwards-Trinity (Plateau) Aquifer	J-54	258	258	258	258	258	258	$2,531,000	1	1 or 2	1 or 2	3	2	3
	City of Leakey	Nueces	Public conservation education	Demand Reduction	J-55	1	1	1	1	1	1	$5,979						
			Additional groundwater well	Lower Trinity Aquifer	J-56	91	91	91	91	91	91	$646,000	n/a	1 or 2	1 or 2	3	2	3
			Develop interconnections between wells within the City	Frio River Alluvium Aquifer	J-57	0	81	81	81	81	81	$791,000	n/a	n/a	n/a	n/a	2	2
	Real County Other - Real WSC	Nueces	Water loss audit and main-line repair	Demand Reduction	J-58	1	1	1	1	1	1	$1,065,000	3	n/a	n/a	2	2	2
	Real County Other - Oakmont Saddle Mountain WSC	Nueces	Additional groundwater well	Frio River Alluvium Aquifer	J-59	54	54	54	54	54	54	$615,000	n/a	1	1	2	2	3
	Real County Other	Nueces	Vegetative Management	Demand Reduction	J-60	0	0	0	0	0	0	$0						
	**Real County Manufacturing	Nueces	Manufacturing Conservation	Demand Reduction	J-61	1	1	1	1	1	1	$0						
Val Verde	*City of Del Rio	Rio Grande	Water loss audit and main-line repair	Demand Reduction	J-62	631	631	631	631	631	631	$89,466,000	3	n/a	n/a	n/a	n/a	n/a
			Additional groundwater well	Edwards-Trinity (Plateau) Aquifer	J-63	7,191	7,191	7,191	7,191	7,191	7,191	$19,764,000	1	1	1	3	2	3
			Water treatment plant expansion	Direct Non-Potable Reuse	J-64	0	943	943	943	943	943	$10,489,000	3	2	1	3	2	2
			Develop a wastewater reuse program	Direct Non-Potable Reuse	J-65	0	3,092	3,092	3,092	3,092	3,092	$11,451,000	3	3	1	1	2	2
	Val Verde County Other - San Pedro Canyon Upper Subdivision	Rio Grande	Water loss audit and main-line repair	Demand Reduction	J-66	3	3	3	3	3	3	$1,065,000	3	n/a	n/a	2	2	2
	Val Verde County Other - Tierra Del Lago	Rio Grande	Water loss audit and main-line repair	Demand Reduction	J-67	5	5	5	5	5	5	$1,065,000	3	n/a	n/a	2	2	2
	Val Verde County Other	Rio Grande	Vegetative Management	Demand Reduction	J-68	0	0	0	0	0	0	$0						
	*Val Verde County Mining	Rio Grande	Mining Conservation	Demand Reduction	J-69	15	16	17	18	19	21	$0						
			Additional groundwater wells	Edwards-Trinity (Plateau) Aquifer	J-70	242	242	242	242	242	242	$1,348,000	2	3	1	3	2	3

Notes:

See Appendix 5B for quantification description of impact ranges.

* WUGs with a projected future supply deficit. *(See Table 4-1 for list of shortages)*

** WUGs with a projected future unmet need

*** Potential Supplies for Vegetative Management under 40% Reduction of Average Rainfall (see table below)

a Quantity Range: 1 = Meets 100% of shortage; 2 = Meets 50 to 99% of shortage; 3 = Meets <50% of shortage *(See Table 4-1 for list of shortages)*

b Quality Range: 1 = Meets safe drinking-water standards; 2 = Must be treated or mixed to meet safe drinking-water standards; 3 = Usable for intended use

c Reliability Range: 1 = Sustainable; 2 = Provides firm supply, but may be partially impacted during drought conditions; 3 = Non-sustainable

d Strategy Impact Range: 1 = Positive, 2 = No New; 3 = Minimal Negative; 4 = Moderate Negative; 5 = Significant Negative

2026 Strategy ID	Water Management Strategy	Average Rainfall Supply in all Decades (ac-ft/yr.)	DOR Rainfall Supply in all Decades (ac-ft/yr.)
J-13	Vegetative Management	2,314	1,388
J-24	Vegetative Management	145	87
J-39	Vegetative Management	218	131
J-51	Vegetative Management	145	87
J-52	Vegetative Management	145	87
J-60 & 68	Vegetative Management	145	87

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Table 5-3. Summary of Recommended and Alternate Water Management Strategy Cost

County	Water User Group	Strategy Source Basin	Strategy	Strategy ID	Total Capital Cost	Annual Cost/Year						Cost per Acre-Foot/Year					
						2030	2040	2050	2060	2070	2080	2030	2040	2050	2060	2070	2080
Bandera	City of Bandera	San Antonio	Water loss audit and main-line repair	J-1	$5,327,000	$375,000	$375,000	$375,000	$375,000	$375,000	$375,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000
			Reuse treated wastewater effluent for irrigation of public spaces	J-2	$2,117,000		$179,000	$179,000	$30,000	$30,000	$30,000		$577	$577	$97	$97	$97
			Promote, design & install rainwater harvesting systems on public buildings	J-3	$83,000		$7,000	$7,000	$1,000	$1,000	$1,000		$7,000	$7,000	$1,000	$1,000	$1,000
			Additional Lower Trinity well and lay necessary pipeline **ALTERNATE**	J-4	$7,067,000		$611,000	$611,000	$114,000	$114,000	$114,000		$1,516	$1,516	$283	$283	$283
			Additional Middle Trinity wells within City water infrastructure area	J-5	$1,115,000	$93,000	$93,000	$14,000	$14,000	$14,000	$14,000	$578	$578	$87	$87	$87	$87
			Surface water acquisition, treatment and ASR	J-6	$50,501,000		$3,570,000	$3,570,000	$17,000	$17,000	$17,000		$2,380	$2,380	$11	$11	$11
	Bandera County FWSD #1	San Antonio	Public conservation education	J-7	$5,342	$876	$893	$893	$894	$893	$893	$256	$257	$252	$246	$241	$237
			Additional groundwater well	J-8	$1,562,000	$153,000	$153,000	$43,000	$43,000	$43,000	$43,000	$1,530	$1,530	$430	$430	$430	$430
	Bandera County-Other (Bridlegate Subdivision)	San Antonio	Water loss audit and main-line repair	J-9	$2,130,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000
	Bandera County-Other (Flying L Ranch PUD)	San Antonio	Water loss audit and main-line repair	J-10	$1,065,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$37,500	$37,500	$37,500	$37,500	$37,500	$37,500
	Bandera County-Other (Medina WSC)	San Antonio	Additional groundwater well	J-11	$2,129,000	$203,000	$203,000	$53,000	$53,000	$53,000	$53,000	$3,691	$3,691	$964	$964	$964	$964
	Bandera County-Other (BCRAGD)	San Antonio	Drought management	J-12	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	***Bandera County-Other	San Antonio	Vegetative Management	J-13	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Bandera County-Other (Volunteer Fire Dept.)	San Antonio	Additional groundwater wells to provide emergency supply **ALTERNATE**	J-14	$7,527,000	$616,000	$616,000	$86,000	$86,000	$86,000	$86,000	$3,259	$3,259	$455	$455	$455	$455
	Bandera County-Other (BCRAGD)	Nueces	Drought management	J-15	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	**Bandera County Irrigation	San Antonio	Irrigation scheduling	J-16	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
			Additional groundwater wells	J-17	$399,000	$34,000	$34,000	$6,000	$6,000	$6,000	$6,000	$453	$453	$80	$80	$80	$80
	*Bandera County Livestock	Nueces	Livestock conservation	J-18	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
			Additional groundwater wells	J-19	$671,000	$52,000	$52,000	$5,000	$5,000	$5,000	$5,000	$6,500	$6,500	$625	$625	$625	$625
Edwards	City of Rocksprings	Nueces	Public conservation education	J-20	$5,555	$1,148	$862	$863	$949	$903	$830	$656	$862	$863	$949	$903	$830
			Water loss audit and main-line repair	J-21	$2,130,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000
			Additional groundwater wells	J-22	$1,020,000	$102,000	$102,000	$30,000	$30,000	$30,000	$30,000	$843	$843	$248	$248	$248	$248
	Edwards County-Other (Barksdale WSC)	Nueces	Additional well in the Nueces River Alluvium Aquifer and RO wellhead treatment	J-23	$317,000	$63,000	$63,000	$41,000	$41,000	$41,000	$41,000	$1,167	$1,167	$759	$759	$759	$759
	***Edwards County-Other	Nueces	Vegetative Management	J-24	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	*Edwards County Irrigation	Rio Grande	Irrigation Scheduling	J-25	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

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Table 5-3. (continued) Summary of Recommended and Alternate Water Management Strategy Cost

County	Water User Group	Strategy Source Basin	Strategy	Strategy ID	Total Capital Cost	Annual Cost/Year						Cost per Acre-Foot/Year					
						2030	2040	2050	2060	2070	2080	2030	2040	2050	2060	2070	2080
Edwards	**Edwards County Livestock	Nueces	Livestock conservation	J-26	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	*Edwards County Mining	Nueces	Mining Conservation	J-27	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
			Additional groundwater well	J-28	$154,000	$13,000	$2,000	$2,000	$2,000	$2,000	$2,000	$813	$813	$125	$125	$125	$125
Kerr	*City of Kerrville	Guadalupe	Increase wastewater reuse	J-29	$23,355,000	$1,340,000	$1,340,000	$246,000	$246,000	$246,000	$246,000	$536	$536	$98	$98	$98	$98
			Water loss audit and main-line repair	J-30	$28,757,000	$2,023,000	$2,023,000	$2,023,000	$2,023,000	$2,023,000	$2,023,000	$48,167	$48,167	$48,167	$48,167	$48,167	$48,167
			Additional groundwater well	J-31	$38,542,000	$3,142,000	$3,142,000	$430,000	$430,000	$430,000	$430,000	$2,718	$2,718	$372	$372	$372	$372
			Increased water treatment and ASR capacity	J-32	$21,621,000		$2,574,000	$2,574,000	$1,053,000	$1,053,000	$1,053,000		$766	$766	$313	$313	$313
	*Kerrville South Water	Guadalupe	Additional groundwater wells	J-33	$2,209,000	$202,000	$202,000	$47,000	$47,000	$47,000	$47,000	$1,010	$1,010	$235	$235	$235	$235
	Kerr County-Other (Eastern Kerr County Regional Water Supply Project)	Guadalupe	Project 1. Construction of an Ellenburger Aquifer water supply well	J-34	$906,000		$97,000	$97,000	$33,000	$33,000	$33,000		$898	$898	$306	$306	$306
			Project 2. Construction of off-channel surface water storage		$39,053,000		$2,005,000	$2,005,000	$176,000	$176,000	$176,000		$1,789	$1,789	$157	$157	$157
			Project 2. Construction of surface water treatment facilities and transmission lines		$48,636,000		$3,875,000	$3,875,000	$455,000	$455,000	$455,000		$3,457	$3,457	$406	$406	$406
			Project 3. Construction of ASR facility		$1,881,000		$145,000	$145,000	$13,000	$13,000	$13,000		$129	$129	$12	$12	$12
			Project 4. Construction of Trinity Aquifer wellfield for dense, rural areas		$13,067,000		$1,179,000	$1,179,000	$260,000	$260,000	$260,000		$1,371	$1,371	$302	$302	$302
			Project 4. Construction of desalination plant		$52,888,000		$9,118,000	$9,118,000	$5,398,000	$5,398,000	$5,398,000		$10,602	$10,602	$6,277	$6,277	$6,277
	Kerr County-Other (Center Point)	Guadalupe	Purchase water from EKCRWSP	J-35	$0		$12,000	$12,000	$12,000	$12,000	$12,000		$1,091	$1,091	$1,091	$1,091	$1,091
	Kerr County-Other (Center Point Taylor System)	Guadalupe	Purchase water from EKCRWSP	J-36	$0		$49,000	$49,000	$49,000	$49,000	$49,000		$1,140	$1,140	$1,140	$1,140	$1,140
	Kerr County-Other (Community Water Group WSC)	Nueces	Water loss audit and main-line repair	J-37	$1,065,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000
	*Kerr County-Other	Colorado	Purchase water from EKCRWSP	J-38	$0	$116,000	$116,000	$116,000	$116,000	$116,000	$116,000	$1,137	$1,137	$1,137	$1,137	$1,137	$1,137
	***Kerr County-Other	Guadalupe	Vegetative Management	J-39	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	*Kerr County Irrigation	Colorado	Irrigation scheduling	J-40	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	*Kerr County Irrigation	San Antonio	Irrigation scheduling	J-41	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	*Kerr County Livestock	Colorado	Livestock conservation	J-42	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
			Additional groundwater wells **ALTERNATE**	J-43	$318,000	$24,000	$24,000	$2,000	$2,000	$2,000	$2,000	$1,000	$1,000	$83	$83	$83	$83
	*Kerr County Livestock	San Antonio	Livestock conservation	J-44	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
			Additional groundwater wells **ALTERNATE**	J-45	$255,000	$24,000	$24,000	$6,000	$6,000	$6,000	$6,000	$444	$444	$111	$111	$111	$111
	*Kerr County Mining	Guadalupe	Mining Conservation	J-46	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
			Additional groundwater wells **ALTERNATE**	J-47	$360,000	$32,000	$32,000	$7,000	$7,000	$7,000	$7,000	$667	$667	$146	$146	$146	$146
Kinney	City of Brackettville	Rio Grande	Increase supply to Spofford with new water line	J-48	$13,196,000		$1,023,000	$1,023,000	$95,000	$95,000	$95,000		$341,000	$341,000	$31,667	$31,667	$31,667
			Increase storage facility	J-49	$1,438,000		$111,000	$111,000	$10,000	$10,000	$10,000		$37,000	$37,000	$3,333	$3,333	$3,333
	Fort Clark Springs MUD	Rio Grande	Increase storage facility	J-50	$2,499,000		$194,000	$194,000	$18,000	$18,000	$18,000		$313	$313	$29	$29	$29

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Table 5-3. (continued) Summary of Recommended and Alternate Water Management Strategy Cost

County	Water User Group	Strategy Source Basin	Strategy	Strategy ID	Total Capital Cost	Annual Cost/Year						Cost per Acre-Foot/Year					
						2030	2040	2050	2060	2070	2080	2030	2040	2050	2060	2070	2080
Kinney	Kinney County Other	Nueces	Vegetative Management	J-51	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Kinney County Other	Rio Grande	Vegetative Management	J-52	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Real	*City of Camp Wood	Nueces	Public conservation education	J-53	$4,697	$920	$757	$763	$782	$752	$722	$920	$757	$763	$782	$752	$722
			Additional groundwater wells	J-54	$2,531,000	$210,000	$210,000	$32,000	$32,000	$32,000	$32,000	$814	$814	$124	$124	$124	$124
	City of Leakey	Nueces	Public conservation education	J-55	$5,979	$1,172	$969	$973	$996	$965	$904	$1,172	$969	$973	$996	$965	$904
			Additional groundwater well	J-56	$646,000	$74,000	$74,000	$29,000	$29,000	$29,000	$29,000	$813	$813	$319	$319	$319	$319
			Develop interconnections between wells within the City	J-57	$791,000		$61,000	$61,000	$5,000	$5,000	$5,000		$753	$753	$62	$62	$62
	Real County Other - Real WSC	Nueces	Water loss audit and main-line repair	J-58	$1,065,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000
	Real County Other - Oakmont Saddle Mountain WSC	Nueces	Additional groundwater well	J-59	$615,000	$47,000	$47,000	$4,000	$4,000	$4,000	$4,000	$870	$870	$74	$74	$74	$74
	Real County Other	Nueces	Vegetative Management	J-60	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	**Real County Manufacturing	Nueces	Manufacturing Conservation	J-61	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Val Verde	*City of Del Rio	Rio Grande	Water loss audit and main-line repair	J-62	$89,466,000	$6,295,000	$6,295,000	$6,295,000	$6,295,000	$6,295,000	$6,295,000	$9,976	$9,976	$9,976	$9,976	$9,976	$9,976
			Additional groundwater well	J-63	$19,764,000	$2,105,000	$2,105,000	$720,000	$720,000	$720,000	$720,000	$293	$293	$100	$100	$100	$100
			Water treatment plant expansion	J-64	$10,489,000		$1,490,000	$1,490,000	$752,000	$752,000	$752,000		$1,580	$1,580	$797	$797	$797
			Develop a wastewater reuse program	J-65	$11,451,000		$888,000	$888,000	$82,000	$82,000	$82,000		$287	$287	$27	$27	$27
	Val Verde County Other - San Pedro Canyon Upper Subdivision	Rio Grande	Water loss audit and main-line repair	J-66	$1,065,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000
	Val Verde County Other - Tierra Del Lago	Rio Grande	Water loss audit and main-line repair	J-67	$1,065,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
	Val Verde County Other	Rio Grande	Vegetative Management	J-68	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	*Val Verde County Mining	Rio Grande	Mining Conservation	J-69	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
			Additional groundwater wells	J-70	$1,348,000	$114,000	$114,000	$19,000	$19,000	$19,000	$19,000	$471	$471	$79	$79	$79	$79

* WUGs with a projected future supply deficit. *(See Table 4-1 for list of shortages)*
** WUGs with a projected future unmet need

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Table 5-4. Summary of Recommended and Alternate Water Management Strategy Environmental Assessments

County	Water User Group	Strategy	Strategy ID	Environmental Impact Factor **					Comments
				Envir. Water Needs	Wildlife Habitat	Cultural Resources	Envir. Water Quality	Bays & Estuaries ***	
				(1-5)	(1-5)	(1-5)	(1-5)		
Bandera	City of Bandera	Water loss audit and main-line repair	J-1	2	2	2	2	n/a	Reduces water loss.
		Reuse treated wastewater effluent for irrigation of public spaces	J-2	2	2	2	2	n/a	Reduces dependence on new groundwater.
		Promote, design & install rainwater harvesting systems on public buildings	J-3	1	1	2	1	n/a	Provides sustainable supplemental fresh water.
		Additional Lower Trinity well and lay necessary pipeline **ALTERNATE**	J-4	2	2	2	2	n/a	Well construction and operation to follow BCRAGD regulations.
		Additional Middle Trinity wells within City water infrastructure area	J-5	2	2	2	2	n/a	Well construction and operation to follow BCRAGD regulations.
		Surface water acquisition, treatment and ASR	J-6	4	2	2	2	n/a	Construction of facilities will displace a small segment of natural habitat. Flow in Medina River would be reduced during periods of diversion.
	Bandera County FWSD #1	Public conservation education	J-7	n/a	n/a	n/a	n/a	n/a	Reduces dependence on existing supply sources.
		Additional groundwater well	J-8	2	2	2	2	n/a	Well construction and operation to follow BCRAGD regulations.
	Bandera County-Other (Bridlegate Subdivision)	Water loss audit and main-line repair	J-9	2	2	2	2	n/a	Reduces water loss.
	Bandera County-Other (Flying L Ranch PUD)	Water loss audit and main-line repair	J-10	2	2	2	2	n/a	Reduces water loss.
	Bandera County-Other (Medina WSC)	Additional groundwater well	J-11	2	2	2	2	n/a	Well construction and operation to follow BCRAGD regulations.
	Bandera County-Other (BCRAGD)	Drought management	J-12	n/a	n/a	n/a	n/a	n/a	Reduces dependence on existing supply sources.
	***Bandera County-Other	Vegetative Management	J-13	n/a	n/a	n/a	n/a	n/a	Reduces dependence on existing supply sources.
	Bandera County-Other (Volunteer Fire Dept.)	Additional groundwater wells to provide emergency supply **ALTERNATE**	J-14	2	2	2	2	n/a	Well construction and operation to follow BCRAGD regulations.
	Bandera County-Other (BCRAGD)	Drought management	J-15	n/a	n/a	n/a	n/a	n/a	Reduces dependence on existing supply sources.
	**Bandera County Irrigation	Irrigation scheduling	J-16	n/a	n/a	n/a	n/a	n/a	Reduces dependence on existing supply sources.
		Additional groundwater wells	J-17	2	2	2	2	n/a	Well construction and operation to follow BCRAGD regulations.
	*Bandera County Livestock	Livestock conservation	J-18	2	1	2	2	n/a	Reduces dependence on existing supply sources.
		Additional groundwater wells	J-19	2	2	2	2	n/a	Well construction and operation to follow BCRAGD regulations.
Edwards	City of Rocksprings	Public conservation education	J-20	n/a	n/a	n/a	n/a	n/a	Reduces dependence on existing supply sources.
		Water loss audit and main-line repair	J-21	2	2	2	2	n/a	Reduces water loss.
		Additional groundwater wells	J-22	2	2	2	2	n/a	Well construction and operation to follow RECRD regulations.
	Edwards County-Other (Barksdale WSC)	Additional well in the Nueces River Alluvium Aquifer and RO wellhead treatment	J-23	2	2	2	2	n/a	Caution is necessary to not overexploit the aquifer.
	***Edwards County-Other	Vegetative Management	J-24	n/a	n/a	n/a	n/a	n/a	Reduces dependence on existing supply sources.
	*Edwards County Irrigation	Irrigation Scheduling	J-25	n/a	n/a	n/a	n/a	n/a	Reduces dependence on existing supply sources.
	**Edwards County Livestock	Livestock conservation	J-26	n/a	n/a	n/a	n/a	n/a	Reduces dependence on existing supply sources.
	*Edwards County Mining	Mining Conservation	J-27	n/a	n/a	n/a	n/a	n/a	Reduces dependence on existing supply sources.
		Additional groundwater well	J-28	2	2	2	2	n/a	Well construction and operation to follow RECRD regulations.
Kerr	*City of Kerrville	Increase wastewater reuse	J-29	2	2	2	2	n/a	Reduces dependence on existing supply sources.
		Water loss audit and main-line repair	J-30	2	2	2	2	n/a	Reduces water loss.
		Additional groundwater well	J-31	2	2	2	2	n/a	Well construction and operation to follow HGCD regulations.
		Increased water treatment and ASR capacity	J-32	2	2	2	2	n/a	Reduces dependence on new groundwater.
	*Kerrville South Water	Additional groundwater wells	J-33	2	2	2	2	n/a	Well construction and operation to follow HGCD regulations.

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Table 5-4. (continued) Summary of Recommended and Alternate Water Management Strategy Environmental Assessments

County	Water User Group	Strategy	Strategy ID	Environmental Impact Factor **					Comments
				Envir. Water Needs (1-5)	Wildlife Habitat (1-5)	Cultural Resources (1-5)	Envir. Water Quality (1-5)	Bays & Estuaries ***	
Kerr	Kerr County-Other (Eastern Kerr County Regional Water Supply Project)	Project 1. Construction of an Ellenburger Aquifer water supply well	J-34	2	2	2	2	n/a	Well construction and operation to follow HGCD regulations.
		Project 2. Construction of off-channel surface water storage		2	1	2	2	n/a	Provides temporary birding habitat.
		Project 2. Construction of surface water treatment facilities and transmission lines		2	3	2	2	n/a	Construction of facilities will displace a small segment of natural habitat.
		Project 3. Construction of ASR facility		2	2	2	2	n/a	Well construction and operation to follow HGCD regulations.
		Project 4. Construction of Trinity Aquifer wellfield for dense, rural areas		2	2	2	2	n/a	Well construction and operation to follow HGCD regulations.
		Project 4. Construction of desalination plant		2	3	2	2	n/a	Construction of facilities will displace a small segment of natural habitat.
	Kerr County-Other (Center Point)	Purchase water from EKCRWSP	J-35	n/a	n/a	n/a	n/a	n/a	Efficiency of supply through a regional project
	Kerr County-Other (Center Point Taylor System)	Purchase water from EKCRWSP	J-36	n/a	n/a	n/a	n/a	n/a	Efficiency of supply through a regional project
	Kerr County-Other (Community Water Group WSC)	Water loss audit and main-line repair	J-37	2	2	2	2	n/a	Reduces water loss.
	*Kerr County-Other	Purchase water from EKCRWSP	J-38	n/a	n/a	n/a	n/a	n/a	Efficiency of supply through a regional project
	***Kerr County-Other	Vegetative Management	J-39	n/a	n/a	n/a	n/a	n/a	Reduces dependence on existing supply sources.
	*Kerr County Irrigation	Irrigation scheduling	J-40	n/a	n/a	n/a	n/a	n/a	Reduces dependence on existing supply sources.
	*Kerr County Irrigation	Irrigation scheduling	J-41	n/a	n/a	n/a	n/a	n/a	Reduces dependence on existing supply sources.
	*Kerr County Livestock	Livestock conservation	J-42	n/a	n/a	n/a	n/a	n/a	Reduces dependence on existing supply sources.
		Additional groundwater wells **ALTERNATE**	J-43	2	2	2	2	n/a	Well construction and operation to follow HGCD regulations.
	*Kerr County Livestock	Livestock conservation	J-44	n/a	n/a	n/a	n/a	n/a	Reduces dependence on existing supply sources.
		Additional groundwater wells **ALTERNATE**	J-45	2	2	2	2	n/a	Well construction and operation to follow HGCD regulations.
	*Kerr County Mining	Mining Conservation	J-46	n/a	n/a	n/a	n/a	n/a	Reduces dependence on existing supply sources.
		Additional groundwater wells **ALTERNATE**	J-47	2	2	2	2	n/a	Well construction and operation to follow HGCD regulations.
Kinney	City of Brackettville	Increase supply to Spofford with new water line	J-48	2	2	2	2	n/a	Temporary land disturbance during excavation for new pipeline.
		Increase storage facility	J-49	2	3	2	2	n/a	Temporary land disturbance during facility construction.
	Fort Clark Springs MUD	Increase storage facility	J-50	2	3	2	2	n/a	Temporary land disturbance during facility construction.
	Kinney County Other	Vegetative Management	J-51	n/a	n/a	n/a	n/a	n/a	Reduces dependence on existing supply sources.
	Kinney County Other	Vegetative Management	J-52	n/a	n/a	n/a	n/a	n/a	Reduces dependence on existing supply sources.
Real	*City of Camp Wood	Public conservation education	J-53	n/a	n/a	n/a	n/a	n/a	Intended to reduce water use.
		Additional groundwater wells	J-54	2	2	2	2	n/a	Well construction and operation to follow RECRD regulations.
	City of Leakey	Public conservation education	J-55	n/a	n/a	n/a	n/a	n/a	Intended to reduce water use.
		Additional groundwater well	J-56	2	2	2	2	n/a	Well construction and operation to follow RECRD regulations.
		Develop interconnections between wells within the City	J-57	2	2	2	2	n/a	Temporary land disturbance during excavation for new pipeline.
	Real County Other - Real WSC	Water loss audit and main-line repair	J-58	2	2	2	2	n/a	Reduces water loss.
	Real County Other - Oakmont Saddle Mountain WSC	Additional groundwater well	J-59	2	2	2	2	n/a	Well construction and operation to follow RECRD regulations.
	Real County Other	Vegetative Management	J-60	n/a	n/a	n/a	n/a	n/a	Reduces dependence on existing supply sources.
	**Real County Manufacturing	Manufacturing Conservation	J-61	n/a	n/a	n/a	n/a	n/a	Reduces dependence on existing supply sources.

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Table 5-4. (continued) Summary of Recommended and Alternate Water Management Strategy Environmental Assessments

County	Water User Group	Strategy	Strategy ID	Environmental Impact Factor **					Comments
				Envir. Water Needs (1-5)	Wildlife Habitat (1-5)	Cultural Resources (1-5)	Envir. Water Quality (1-5)	Bays & Estuaries ***	
Val Verde	*City of Del Rio	Water loss audit and main-line repair	J-62	2	2	2	2	n/a	Reduces water loss.
		Additional groundwater well	J-63	2	2	2	2	n/a	Temporary land disturbance during drilling, completion, and pipeline connection.
		Water treatment plant expansion	J-64	2	3	2	2	n/a	Temporary land disturbance during facility construction.
		Develop a wastewater reuse program	J-65	1	2	2	2	n/a	Temporary land disturbance during placement of new reuse distribution pipelines.
	Val Verde County Other - San Pedro Canyon Upper Subdivision	Water loss audit and main-line repair	J-66	2	2	2	2	n/a	Reduces water loss.
	Val Verde County Other - Tierra Del Lago	Water loss audit and main-line repair	J-67	2	2	2	2	n/a	Reduces water loss.
	Val Verde County Other	Vegetative Management	J-68	n/a	n/a	n/a	n/a	n/a	Reduces dependence on existing supply sources.
	*Val Verde County Mining	Mining Conservation	J-69	n/a	n/a	n/a	n/a	n/a	Reduces dependence on existing supply sources.
		Additional groundwater wells	J-70	2	2	2	2	n/a	Temporary land disturbance during drilling and completion of well.

* WUGs with a projected future water supply deficit. *(See Table 4-1 for list of shortages)*
See Appendix 5B for quantification description of impact ranges.
** Strategy impact range: 1 = Positive; 2 = No New; 3 = Minimal Negative; 4 = Moderate Negative; 5 = Significant Negative
*** All strategies occur beyond the distance of potential impact to flows into the coastal bay and estuary systems.

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5.3 WATER CONSERVATION

Water conservation is one of the most important components of water supply management. Recognizing its impact, setting realistic goals, and aggressively enforcing implementation may significantly extend the time when new supplies and associated infrastructure are needed. This Chapter explores conservation opportunities and best management practices and provides a road map for integrating conservation planning into long-range water supply management goals.

5.3.1 State Water Conservation Overview

The TWDB defines "conservation" as those practices, techniques, programs, and technologies that will protect water resources, reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or increase the recycling or reuse of water so that a water supply is made available for future or alternative uses. Water conservation management strategies recommended in Chapter 5 include water loss audits to reduce distribution losses, public conservation awareness, and brush management.

Effective conservation programs implement best management practices to try to meet the targets and goals identified within the *Plan* and are important to water conservation planning for all entities such as: municipal, agricultural, industrial, and commercial. Water conservation management planning currently implemented by municipalities, agricultural and commercial interests, and other water users supersede recommendations in this *Plan* and are considered consistent with this *Plan.*

The TWDB and the TSSWCB jointly conducted a study of ways to improve or expand water conservation efforts in Texas. The results of that study are available in a joint 2018 report titled "An Assessment of Water Conservation in Texas, Prepared for the 85th Texas Legislature" and contains the following:

- An assessment of both agricultural and municipal water conservation issues.
- Information on existing conservation efforts by the TWDB and the TSSWCB.
- Information on existing conservation efforts by municipalities receiving funding from the TWDB, as specified in water conservation plans submitted by the municipalities as part of their applications for assistance.
- A discussion of future conservation needs.
- An analysis of programmatic approaches and funding for additional conservation efforts.
- An assessment of existing statutory authority and whether changes are needed to more effectively promote and fund conservation projects.
- An assessment of the TWDB's agricultural water conservation program.

The implementation of water conservation programs that are cost effective, meet State mandates, and result in permanent real reductions in water use will be a challenge for the citizens of the Plateau Region. Smaller communities that lack financial and technical resources will be particularly challenged and will look to the State for assistance.

Since portions of the Region are particularly susceptible to water-supply shortages during periods of drought conditions, these areas are especially encouraged to develop conservation-oriented management plans. Likewise, water-user entities within these areas should become actively involved in the regional water planning activities associated with this *Plan.*

The PWPG considers all groundwater sources recognized in this P*lan* as being critical to the future health and economic welfare of the Plateau Region. Due to the Region's reliance on groundwater to meet current and future water needs, the PWPG recommends that local groundwater conservation districts be formed throughout the entire Region to administer sound, reasonable, and scientifically based management objectives; and that these districts play a major role in the regional water planning process.

It is generally recognized that brush infestations are the symptom of deeper ecological disturbances such as fire control, drought, grazing mismanagement, wildlife overpopulations and other causes. Selective Brush Management, as a tool to improve watershed yields and water quality, is a conservation management strategy of great interest in the Plateau Region, as well as in surrounding planning regions. A program is in place and administered through the TSSWCB to provide a cost-share funding program to landowners in the targeted watersheds for the Selective Brush Management. Funding for this program should be targeted on selected areas identified through modeling.

The PWPG joins with the Rio Grande Region (M) and the Far West Texas Region (E) in encouraging funding for projects aimed at the eradication and long-term suppression of salt cedar and other nuisance phreatophytes in the Rio Grande watershed.

5.3.2 Model Water Conservation Plans

Water Conservation Plan forms are available from TCEQ in Microsoft Word and PDF formats. The forms for the following entity types listed below are available either on the TWDB's Water Conservation Plans webpage or on the TCEQ's Water Conservation website.

You can receive a print copy of a form by calling 512/239-4691 or by email to wras@tceq.texas.gov.

Municipal Use – Utility Profile and Water Conservation Plan Requirements for Municipal Water Use by Public water Suppliers (TCEQ-10218) Word

Wholesale Public Water Suppliers – Profile and Water Conservation Plan Requirements for Wholesale Public Water Suppliers (TCEQ-20162) Word

Industrial Use – Industrial Water Conservation Plan (TCEQ-20839) Word

Mining Use – Mining Water Conservation Plan (TCEQ-20840) Word

Agricultural Uses – Agriculture Water Conservation Plan-Non-Irrigation (TCEQ-10541) Word

System Inventory and Water Conservation Plan for Individually-Operated Irrigation System (TCEQ-10238) Word

System Inventory and Water Conservation Plan for Agricultural Water Suppliers Providing Water to More Than One User (TCEQ-10244) Word

5.3.3 State Water Conservation Programs and Guides

The TWDB provides a significant amount of information and services pertaining to water conservation that can be accessed at TWDB Water Conservation.

Likewise, water conservation tips developed by the TCEQ and made available through their Take Care of Texas educational campaign can be accessed at TCEQ's Water Conservation webpage.

Water-Saving Plumbing Fixture Program

The Texas Legislature created the Water-Savings Plumbing Fixture Program on Jan. 1, 1992, to promote water conservation. Manufacturers of plumbing fixtures sold in Texas must comply with the Environmental Performance Standards for Plumbing Fixtures, which requires all plumbing fixtures such as showerheads, toilets and faucets sold in Texas to conform to specific water use efficiency standards.

As of January 1, 2014, Texas (House Bill 2667) mandates all toilets and urinals sold in Texas must meet new efficiency standards.

- Bath faucets cannot exceed 2.2 gpm.
- Showerheads cannot exceed 2.5 gpm.
- Kitchen faucets cannot exceed 2.2 gpm.
- Toilets cannot exceed 1.28 gallons per flush (gpf).
- Urinals cannot exceed 0.5 gpf.

Since more water is used in the bathroom than any other place in the home, water-efficient plumbing fixtures play an integral role in reducing water consumption, wastewater production, and consumers' water bills. It is estimated that switching to water-efficient fixtures can save the average household between $50 and $100 per year on water and sewer bills. Many hotels and office buildings find that water-efficient fixtures can save 20 percent on water and wastewater costs.

The EPA's WaterSense program labels water-efficient products that meet most of the criteria above, and on average are certified to use at 20 percent less water than legacy fixtures. Their website also provides a product search tool and a rebate finder.

Water Conservation Best Management Practices

The 78th Texas Legislature under Senate Bill 1094 created the Texas Water Conservation Implementation Task Force and charged the group with reviewing, evaluating, and recommending optimum levels of water use efficiency and conservation for the State. The TWDB and TCEQ in coordination with the Water Conservation Advisory Council prepared TWDB Report 362, Water Conservation Best Management Practices Guides for agricultural, commercial, institutional, and industrial water users. In addition, guides were developed for both municipal and WWPs. These suggested BMPs are structured for delivering a conservation measure or series of measures that are useful, proven, cost-effective, and generally accepted among conservation experts. Each BMP structure has several elements that describe the efficiency measures, implementation techniques, schedule of implementation, scope, water savings estimating procedures, cost effectiveness considerations, and references to assist end-users in implementation. These documents can be accessed here:

- TWDB Report 362 - Water Conservation Implementation Task Force: Water Conservation Best Management Practices Guide
- An update to the introduction in TWDB Report 362 can be found here: Water Conservation Best Management Practices - Understanding Best Management Practices

Public Water Conservation Education

Public education may be one of the most productive actions that can result in the greatest amount of water savings. Most citizens are willing to actively do their part to conserve water once the need is communicated and how to accomplish the most benefit is explained. Numerous state, county, and academic agencies provide educational material and demonstrations. Groundwater conservation districts also provide water conservation activities.

The TWDB provides a significant amount of information and services pertaining to water conservation that can be accessed at: TWDB Water Conservation.

Likewise, water conservation tips developed by the TCEQ and made available through their Take Care of Texas educational campaign can be accessed at the following website: Take Care of Texas: Conserve & Keep Water Clean.

TPWD also offers programs geared toward the appreciation and conservation of the State's outdoor natural resources which include:

- Freshwater Inflows and Estuaries.
- Coastal Studies.
- River Studies.
- Texas Gulf Ecological Management Sites.

Education of our youth may be one of the best ways to spread the word about conservation of water. The TWDB provides excellent educational programs for all grade levels K-12th. Information pertaining to this program can be accessed at: TWDB Kids.

The Groundwater Conservation Districts in the Far West Texas Region have water conservation management goals that include:

- Publishing conservation articles in local newspapers.
- Providing conservation presentations and demonstrations at county shows.
- Conducting school programs relating to conservation issues.
- Working with river authorities to promote the clean rivers program.

Watershed Best Management Practices

Watershed best management practices are activities taken to manage, protect, and restore the quality of water resources. Best management practices are designed to consider a variety of water uses and maximize conservation. The Environmental Protection Agency has put together a list of fourteen recommended BMPs and have developed a siting tool which identifies potential suitable locations for implementing different types of BMPs that have proven to be helpful in water conservation efforts. Several of these practices are discussed further for being cost effective, practical, and efficient for the Plateau Region.

Brush Management

A potential means of increasing water supply is to reduce the amount of water consumed by shrubs and trees on rangelands. The density and coverage of shrubs has increased dramatically during the past century as former grasslands have now converted to shrub-lands or closed-canopy woodlands. A total loss of herbaceous vegetation cover will increase water yields in the form of surface runoff. However, this process will accelerate erosion, degrade water quality, and damage aquatic ecosystems. A more desirable way of increasing water yield is to manage vegetation to decrease evapotranspiration, which will generally increase the amount of water that percolates below the root zone into groundwater and eventually back into streams. Researchers[1] believe it is appropriate to broaden the issue from solely focusing on "brush control for increasing water yield" to "best management practices for watershed health and sustainability." See Section 5.2.8 of this Chapter for further discussion on vegetative management as water management strategy.

Rainwater Harvesting

The following discussion on Rainwater Harvesting is taken from the TWDB's 'The Texas Manual on Rainwater Harvesting,' 3rd Edition.

Rainwater is valued for its purity and softness. It has a nearly neutral pH, and is free from disinfection by-products, salts, minerals, and other natural man-made contaminants. Plants thrive under irrigation with stored rainwater. Appliances last longer when free from the corrosive or scale effects of hard water. Users with potable systems prefer the superior taste and cleansing properties of rainwater. Rainwater harvesting, in its essence, is the collection, conveyance, and storage of rainwater.

Rainwater harvesting systems can be as simple as a rain barrel for garden irrigation at the end of a downspout, or as complex as a domestic potable system or a multiple end-use system at a large corporate campus. Advantages and benefits of rainwater harvesting are numerous (Krishna, 2003):

- The water is free; the only cost is for collection and use.
- The end use of harvested water is located close to the source, eliminating the need for complex and costly distribution systems.
- Rainwater provides a water source when groundwater is unacceptable or unavailable, or it can augment limited groundwater supplies.
- The zero hardness of rainwater helps prevent scale on appliances, extending their use; rainwater eliminates the need for a water softener and the salts added during the softening process.
- Rainwater is sodium free, important for persons on low sodium diets.
- Rainwater is superior for landscape irrigation.
- Rainwater harvesting reduces flow to storm water drains and reduces non-point source pollution.
- Rainwater harvesting helps utilities reduce the summer demand peak and delay expansion of existing water treatment plants.
- Rainwater harvesting reduces consumers' utility bills.

[1]Wilcox, B.P., Dugas, W.A., Owens, M.K., Ueckert, D.N., and Hart, C.R., 2005, Shrub Control and Water Yield on Texas Rangelands, Current State of Knowledge: Texas Agricultural Experiment Station Research Report 05-1.

The TWDB has a rainwater harvesting webpage that focuses on rainwater projects, training, the Texas Rain Catcher Award and FAQs.

Landscape Maintenance

A significant amount of water is used each year in the maintenance of residential and non-residential landscapes. Landscape irrigation conservation practices are an effective method of accounting for and reducing outdoor water usage while maintaining healthy landscapes and avoiding runoff. Water wise landscape programs should follow the seven principals of xeriscape:

- Planning and design.
- Soil analysis and improvement.
- Appropriate plant selection.
- Practical turf area.
- Efficient irrigation.
- Use of mulch.
- Appropriate maintenance.

Additional detail on this subject is available in TWDB Report 362 'Water Conservation Best Management Practices Guide.

Water Loss Audit

Reported municipal use generally includes a variable amount of water that does not reach the intended consumer due to water leaks in the distribution lines, unauthorized consumption, storage tank overflows, and other wasteful factors. For some communities, attending to these issues can be a proactive conservation strategy that may result in significant water savings.

To address the lack of information on water loss, the 78th Texas Legislature passed House Bill 3338, which required retail public utilities that provide potable water to perform and file with the TWDB a water audit computing the utility's most recent annual system water loss every five years. In response to the mandate of House Bill 3338, TWDB developed a water audit methodology for utilities to quantify water losses, standardize water loss reporting and help measure water efficiency. This standardized approach to auditing water loss provides utilities with a reliable means to analyze their water loss performance. Utilizing a methodology derived from the AWWA and the IWA, the TWDB has published a manual that outlines the process of completing a water loss audit: "Water Loss Audit Manual for Texas Utilities" – TWDB Report 367 (2008).

Additionally, for the sixth cycle of regional water planning, the TWDB developed several helpful resource guides regarding water loss performance targets and water loss threshold values. These documents can be accessed on the TWDB's website page titled Conservation Resources for 2026 Regional Water Plan Development.

The TWDB provides a significant amount of information and services pertaining to water loss audit that can be accessed on their website.

Additional resources and appropriate forms provided by TWDB include:

- Water Audit Worksheet Instructions.
- Water Loss Guidance.
- Guidelines for Setting a Target Infrastructure Leakage Index (ILL).
- Water Loss Manual for Texas Utilities (Updated March 2008).
- Main Line Water Loss Calculator.
- Monthly Water Loss Report.
- Leak Detection Loan Form.
- Ultrasonic Flow Meter Equipment Loan Form.

5.3.4 Regional Conservation Water Management Strategies

Many of the recommended water management strategies listed in are classified as "Conservation" and are first to be considered in meeting future water-supply needs. These strategies compiled are listed in Table 5-5 and include:

- Water loss audit and main-line repair
- Vegetative management
- Drought management
- On-site reuse
- Public conservation awareness
- Specified activities for irrigation and livestock use

New to this planning cycle, the TWDB requires that regional water plans separate conservation strategies and their projects into either a *Conservation – water loss mitigation* or *Conservation – water use reduction* water management strategy type. Table 5-6 presents the breakout of those two different types of conservation water management strategies.

Table 5-5. Conservation Water Management Strategies

County	Water User Group	Source Basin	Strategy	Strategy ID
Bandera	City of Bandera	San Antonio	Water loss audit and main-line repair	J-1
	Bandera County FWSD #1	San Antonio	Public conservation education	J-7
	Bandera County Other Bridlegate Subdivision	San Antonio	Water loss audit and main-line repair	J-9
	Bandera County Other Flying L Ranch PUD	San Antonio	Water loss audit and main-line repair	J-10
	Bandera County Other	San Antonio	Drought management	J-12
		San Antonio	Vegetative management	J-13
		Nueces	Drought management	J-15
	Bandera County Irrigation	San Antonio	Irrigation scheduling	J-16
	Bandera County Livestock	Nueces	Livestock conservation	J-18
Edwards	City of Rocksprings	Nueces	Public conservation education	J-20
			Water loss audit and main-line repair	J-21
	Edwards County Other	Nueces	Vegetative management	J-24
	Edwards County Irrigation	Rio Grande	Irrigation scheduling	J-25
	Edwards County Livestock	Nueces	Livestock conservation	J-26
	Edwards County Mining	Nueces	Mining Conservation - On-site reuse	J-27
Kerr	City of Kerrville	Guadalupe	Water loss audit and main-line repair	J-30
	Kerr County Other (Community Water Group WSC)	Nueces	Water loss audit and main-line repair	J-37
	Kerr County Other	Guadalupe	Vegetative management	J-39
	Kerr County Irrigation	Colorado	Irrigation scheduling	J-40
		San Antonio	Irrigation scheduling	J-41
	Kerr County Livestock	Colorado	Livestock conservation	J-42
		San Antonio	Livestock conservation	J-44
	Kerr County Mining	Guadalupe	Mining conservation - On-site reuse	J-46
Kinney	Kinney County Other	Nueces	Vegetative management	J-51
		Rio Grande	Vegetative management	J-52
Real	City of Camp Wood	Nueces	Public conservation education	J-53
	City of Leakey	Nueces	Public conservation education	J-55
	Real County Other (Real WSC)	Nueces	Water loss audit and main-line repair	J-58
	Real County Other	Nueces	Vegetative management	J-60
	Real County Manufacturing	Nueces	Manufacturing Conservation	J-61
Val Verde	City of Del Rio	Rio Grande	Water loss audit and main-line repair	J-62
	Val Verde County Other	Rio Grande	Water loss audit and main-line repair for San Pedro Canyon Subdivision (Upper)	J-66
			Water loss audit and main-line repair for Tierra Del Lago	J-67
	Val Verde County Other	Rio Grande	Vegetative management	J-68
	Val Verde County Mining	Rio Grande	Mining conservation - On-site reuse	J-69

Table 5-6. Summary of Recommended Conservation Water Management Strategy Evaluations by Type

County	Water User Group	Source Basin	Strategy Type	Strategy	Strategy ID
Bandera	City of Bandera	San Antonio	Water loss mitigation	Water loss audit and main-line repair	J-1
	Bandera County FWSD #1	San Antonio	Water use reduction	Public conservation education	J-7
	Bandera County Other Bridlegate Subdivision	San Antonio	Water loss mitigation	Water loss audit and main-line repair	J-9
	Bandera County Other Flying L Ranch PUD	San Antonio	Water loss mitigation	Water loss audit and main-line repair	J-10
	Bandera County Other	San Antonio	Water use reduction	Drought management	J-12
		San Antonio	Water use reduction	Vegetative management	J-13
		Nueces	Water use reduction	Drought management	J-15
	Bandera County Irrigation	San Antonio	Water use reduction	Irrigation scheduling	J-16
	Bandera County Livestock	Nueces	Water use reduction	Livestock conservation	J-18
Edwards	City of Rocksprings	Nueces	Water use reduction	Public conservation education	J-20
			Water loss mitigation	Water loss audit and main-line repair	J-21
	Edwards County Other	Nueces	Water use reduction	Vegetative management	J-24
	Edwards County Irrigation	Rio Grande	Water use reduction	Irrigation scheduling	J-25
	Edwards County Livestock	Nueces	Water use reduction	Livestock conservation	J-26
	Edwards County Mining	Nueces	Water use reduction	Mining Conservation - On-site reuse	J-27
Kerr	City of Kerrville	Guadalupe	Water loss mitigation	Water loss audit and main-line repair	J-30
	Kerr County Other (Community Water Group WSC)	Nueces	Water loss mitigation	Water loss audit and main-line repair	J-37
	Kerr County Other	Guadalupe	Water use reduction	Vegetative management	J-39
	Kerr County Irrigation	Colorado	Water use reduction	Irrigation scheduling	J-40
		San Antonio	Water use reduction	Irrigation scheduling	J-41
	Kerr County Livestock	Colorado	Water use reduction	Livestock conservation	J-42
		San Antonio	Water use reduction	Livestock conservation	J-44
	Kerr County Mining	Guadalupe	Water use reduction	Mining conservation - On-site reuse	J-46
Kinney	Kinney County Other	Nueces	Water use reduction	Vegetative management	J-51
		Rio Grande	Water use reduction	Vegetative management	J-52
Real	City of Camp Wood	Nueces	Water use reduction	Public conservation education	J-53
	City of Leakey	Nueces	Water use reduction	Public conservation education	J-55

Table 5-6. (continued) Summary of Recommended Conservation Water Management Strategy Evaluations by Type

County	Water User Group	Source Basin	Strategy Type	Strategy	Strategy ID
Real	Real County Other (Real WSC)	Nueces	Water loss mitigation	Water loss audit and main-line repair	J-58
	Real County Other	Nueces	Water use reduction	Vegetative management	J-60
	Real County Manufacturing	Nueces	Water use reduction	Manufacturing Conservation	J-61
Val Verde	City of Del Rio	Rio Grande	Water loss mitigation	Water loss audit and main-line repair	J-62
	Val Verde County Other	Rio Grande	Water loss mitigation	Water loss audit and main-line repair for San Pedro Canyon Subdivision (Upper)	J-66
			Water loss mitigation	Water loss audit and main-line repair for Tierra Del Lago	J-67
	Val Verde County Other	Rio Grande	Water use reduction	Vegetative management	J-68
	Val Verde County Mining	Rio Grande	Water use reduction	Mining conservation - On-site reuse	J-69

5.3.5 Municipal Conservation Programs

Texas Water Code §11.1271 requires water conservation plans for all municipal and industrial water users with surface water rights of 1,000 ac-ft per year or more and irrigation water users with surface water rights of 10,000 ac-ft per year or more. Also, all entities with 3,300 or more connections and/or a financial obligation with TWDB greater than $500,000 are required to submit water conservation plans. Water conservation plans have been developed for the cities of Kerrville and Del Rio, which meet these criteria. The Upper Guadalupe River Authority, which also has water rights that meet the criteria, is not currently providing water and therefore has not developed a conservation plan under the above TWC requirement. However, UGRA does have a Water Conservation/Drought Management Plan, which was adopted in 1993. Water conservation plans are also required for all other water users applying for a State water right and may also be required for entities seeking State funding for water supply projects.

5.3.6 Irrigation Conservation

Irrigated agriculture is the biggest user of water in Texas. Approximately 7.5 million ac-ft was represented within the 2020 planning decade, of the 2022 State Water Plan. Irrigation water use represents 45 percent of total water use in the State. This is 10 percent greater than municipal water use, which ranks as the second largest use of water State-wide.

On a regional level, irrigation represents approximately 30 percent of all the water used in the Plateau Water Planning area. During significantly dry periods, insufficient water is available to meet the full permitted allotments, and farmers in these areas have generally approached this situation by reducing acreage irrigated, changing types of crops planted, or possibly not planting crops until water becomes available during the following season. In some cases, farmers may benefit from management practices described in Chapter 5, which are a mixture of site-specific management, educational, and physical procedures that have proven to be effective and are cost-effective for conserving water.

The implementation of water conservation programs that are cost effective, meet State mandates, and result in permanent real reductions in water use will be a challenge for the citizens of the Plateau Water

Planning area. Smaller communities that lack financial and technical resources will be particularly challenged and will look to the State for assistance. Irrigation conservation may result in significant reductions in water use. However, without financial and technical assistance, it is unlikely that aggressive irrigation conservation programs will be implemented.

5.3.7 Manufacturing Conservation

Manufacturing water use is one of the three largest uses of water in Texas. In the 2022 State Water Plan, approximately 1.7 million ac-ft was reported within the 2020 planning decade. This represents 10 percent of total water use in the State. In the Plateau Water Planning Region, manufacturing water use accounts for less than one percent of the total non-municipal water use. The use of water for manufacturing purposes only occurs in Kerr, Real and Val Verde Counties (Table 2-7).

Refinery water consumption depends primarily on which of three configurations (cracking, light coking, and heavy coking) is utilized. These processes consume 14 to 20 gallons of water per barrel of crude processed.

Water consumption at most refineries includes cooling water evaporation loss, water embedded with product, steam trap losses, steam vent losses firewater main leaks to ground, evaporation from usage during maintenance, and evaporation from open water ponds in the w wastewater treatment plant (WWTP).

Recent improved practices across the industry include the following:

- Monitoring of steam used to purge and disperse flare tips.
- Replacing turbines that vent steam to the atmosphere with non-vented options.
- Capturing blowdown water from boilers in lower-pressure drum and cooling before sending to WWTP.
- Identifying and minimizing steam leaks.
- Rerouting steam traps that vent to ground to condensate recovery headers.
- Capturing steam lost through top of de-aerators.

5.3.8 Gallons Per Capita Daily Goals

Effective municipal conservation can best be monitored in terms of reduction in gallons per day per capita (gpcd). The PWPG decided to utilize the maximum historical gpcd (2010-2020) for 10 of the 17 WUGs within the Region. The remaining seven WUGs calculated projected water demands by using the 2021 Plan values. In addition, the TWDB established several key changes to the water demand projection methodology for the sixth cycle of regional water planning. One of the key changes assumes that the expected water efficiency savings by replacement and new growth would reasonably be fully realized by the first projected decade of 2030, based on the effective year of the relevant plumbing code savings projections for the current planning cycle. Plumbing code savings from 2040 through 2080 are held constant.

Table 5-7 presents the PWPG approved 2020 base gpcds, along with the projected gpcd reductions in 2030 which includes plumbing code savings. The planning group recommends conservation water management strategies (water loss audit and main-line repair) for eight entities listed below. More detail related to those water management strategies can be found in Appendix 5A. It is highly recommended that these entities take advantage of a water loos audit to guide needed repairs.

Table 5-7. Gallons Per Capita Daily Goals

Water User Group	Base 2020 gpcd	Adjusted 2030 gpcd	Adjusted 2040 gpcd	Adjusted 2050 gpcd	Adjusted 2060 gpcd	Adjusted 2070 gpcd	Adjusted 2080 gpcd
*Bandera	174	169	168	168	168	168	168
Bandera County FWSD #1	289	284	284	284	284	284	284
Brackettville	442	437	437	437	437	437	437
Camp Wood	391	386	386	386	386	386	386
*County-Other, Bandera	102	97	97	97	97	97	97
County-Other, Edwards	108	103	103	103	103	103	103
*County-Other, Kerr	150	145	145	145	145	145	145
County-Other, Kinney	127	121	121	121	121	121	121
*County-Other, Real	103	98	97	97	97	97	97
*County-Other, Val Verde	126	121	121	121	121	121	121
*Del Rio Utilities	327	322	322	322	322	322	322
Fort Clark Springs MUD	478	473	473	473	473	473	473
*Kerrville	217	212	211	211	211	211	211
Kerrville South Water	118	113	113	113	113	113	113
Laughlin Air Force Base	533	528	527	527	527	527	527
Leakey	611	606	605	605	605	605	605
*Rocksprings	239	234	234	234	234	234	234

*Entities that have water loss audit & main-line repair strategies.

Significantly more restrictive measures should be initiated in response to varying degrees of drought conditions such as:

- Mild Drought (Stage 1) – 10 percent reduction.
- Moderate Drought (Stage 2) – 20 percent reduction.
- Severe Drought (Stage 3) – 30 percent reduction.
- Extreme Drought (Stage 4) – 40 percent reduction.

5.3.9 Groundwater Conservation District Management Plans

The Texas Legislature has established a process for local management of groundwater resources through Groundwater Conservation Districts. The districts are charged with managing groundwater by providing for the conservation, preservation, protection, recharging and prevention of waste of groundwater within their jurisdictions. An elected board governs these districts and establishes rules, programs and activities specifically designed to address local problems and opportunities. Texas Water Code §36.0015 states, in part, "Groundwater Conservation Districts created as provided by this chapter are the state's preferred method of groundwater management." Four districts are currently in operation within the planning Region.

- Bandera County River Authority and Groundwater District.
- Headwaters Groundwater Conservation District (Kerr County).
- Kinney County Groundwater Conservation District.
- Real-Edwards Conservation and Reclamation District.

In recent sessions, the Texas Legislature has redefined the way groundwater is to be managed by Groundwater Management Areas. The TWDB provides more information regarding GMAs. This new process is summarized in Chapter 1, Section 1.1.6. The Real-Edwards and a portion of Kinney districts are in GMA 7; while the Bandera and Kerr (Headwaters) districts are in GMA 9. A portion of the Kinney district is in GMA 10.

As part of the joint planning process, groundwater conservation districts are responsible for determining the desired future conditions within a management area. Desired future conditions are defined in Title 31, Part 10, §35601. (6) of the TAC 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." Desired future conditions are implemented to help meet the planning goal for the conservation of water that is to be used for future uses. More information regarding DFCs can be found on the TWDB's website.

Based on adopted desired future conditions, the TWDB estimates the amount of withdrawals that can occur over a specified time (modeled available groundwater) that does not deplete the aquifer beyond the stated desired future condition. As of May 1, 2021, desired future conditions have been adopted and modeled available groundwater has been determined for the following aquifers in the Plateau Region: Trinity, Edwards Group of the Edwards Trinity (Plateau), Edwards BFZ, and Edwards-Trinity (Plateau).

Bandera County River Authority and Groundwater District

The Bandera County River Authority and Groundwater District was originally the Bandera County River Authority, created by the Texas legislature in 1971, and the Springhill's Water Management District, created by the legislature in 1989. The authority of the Bandera County River Authority was incorporated into the Springhill's Water Management District, and in 2003 the TCEQ authorized changing the District's name to Bandera County River Authority and Groundwater District. The District includes all of Bandera County within its jurisdiction. The mission of the District is to manage, protect and conserve the County's water and natural resources, while protecting private property rights. The approved 2023 Management Plan is available on their website, or by following the link above.

Adopted Future Conditions for Bandera County

Aquifer	Edwards Group of the Edwards-Trinity (Plateau)	Trinity
DFC	No net increase in average drawdown through 2080	Increase in average drawdown of approximately 30 feet through 2080

Headwaters Groundwater Conservation District

The Headwaters Groundwater Conservation District is part of the Hill Country Priority Groundwater Management Area (9) and was created by the Texas legislature in 1991 (HB 1463). The District includes all of Kerr County within its jurisdiction. The District's approved 2022 Amended Plan is available on their website, or by following the link above.

The purpose of the District is to provide for the conservation, preservation, protection, recharging and prevention of waste of groundwater reservoirs or their subdivisions within the defined boundaries of the District. The District is responsible for registering and permitting wells drilled in the County, along with conducting aquifer analysis to help determine appropriate plans for future development.

Adopted DFCs for the aquifers in Kerr County are shown below. With regards to the Edwards Group of the Edwards-Trinity (Plateau) Aquifer, GMA 9 declares it 'non-relevant.' Districts in a groundwater management area may, as part of the process for adopting and submitting desired future conditions, propose classification of a portion or portions of a relevant aquifer as non-relevant (31 TAC 356.31 (b)). This classification of an aquifer is made if the districts determine that aquifer characteristics, groundwater demands, and current groundwater uses do not warrant adoption of a desired future condition. Further details explaining 'non-relevant' aquifers can be at TWDB website.

Adopted Desired Future Conditions for Kerr County

Aquifer	Edwards Group of the Edwards-Trinity (Plateau)	Trinity
DFC	Non-relevant	Increase in average drawdown of approximately 30 feet through 2080.

Kinney County Groundwater Conservation District

The Kinney County Groundwater Conservation District was created by the legislature in 2001 (HB 3243) and was confirmed by the voters of Kinney County in 2002. The District includes all of Kinney County within its jurisdiction. The District was created to develop, promote, and implement water conservation and management strategies to conserve, preserve, protect groundwater supplies within the District, protect and enhance recharge, prevent waste and pollution, and to promote the efficient use of groundwater within the District. The approved 2023 Management Plan includes goals such as: provide the most efficient and sustainable use of groundwater; address conjunctive surface water management issues; address drought conditions and participate in the development of desired future conditions of aquifers.

Adopted Desired Future Conditions for Kinney County (GMA 7)

Aquifer	Edwards-Trinity (Plateau)	Trinity
DFC	Drawdown which is consistent with maintaining an annual average flow of 23.9 cfs and an annual median flow of 23.9 cfs at Las Moras Springs.	

Adopted Desired Future Conditions for Kinney County (GMA 10)

Aquifer	Edwards BFZ (GMA10)	Edwards-Trinity (Plateau)
DFC	Water level in well 70-38-902 (J-17) shall not fall below 1,184 feet MSL as mandated by Edwards Aquifer Authority legislation.	

Real-Edwards Conservation and Reclamation District

The Real-Edwards Conservation and Reclamation District was formed by the Texas legislature in 1959 (HB 447) and includes all of Real and Edwards Counties within its jurisdiction. The District was created to provide for the conservation preservation, protection, recharge and prevention of waste of the underground water reservoirs located under the District. The District strives to bring about conservation, preservation and the efficient, beneficial and wise use of water for the benefit of the citizens and the economy of the District through monitoring and protecting the quantity and quality of the groundwater. The District also aims to maintain groundwater ownership and rights of the landowners.

District activities include regulating groundwater withdrawals by means of spacing and production limits, using the TWDB's observation network to monitor changing storage conditions of groundwater supplies within the District, undertaking, as necessary, and cooperating with investigations of the groundwater resources within the District and making the results of investigations available to the public upon adoption by the Board, and potentially requiring reduction of groundwater withdrawals to amounts which will not cause harm to the aquifer.

Adopted Desired Future Conditions for Real County (GMA 7)

Aquifer	Edwards-Trinity (Plateau)	Trinity (Real County)
DFC	Total net drawdown not to exceed 4 feet in 2070 as compared to 2010 aquifer levels	

Adopted Desired Future Conditions for Edwards County (GMA 7)

Aquifer	Edwards-Trinity (Plateau)	Trinity (Real County)
DFC	Total net drawdown not to exceed 2 feet in 2070 as compared to 2010 aquifer levels	

5.3.10 Upper Guadalupe River Authority Conservation Program

The Upper Guadalupe River Authority (UGRA) provides a significant conservation outreach program serving citizens of Kerr County. Two full-time employees focus on public education programs and activities with emphasis on water conservation. Recent water conservation programs and activities include:

- Working with TPWD on the Healthy Creeks Initiative, assisting landowners with control and management of giant cane (*Arundo doanx*).
- Partnering with the Hill Country Master Gardeners on planning, design, and maintenance of the UGRA EduScape, which is a major landscape project providing educational venues demonstrating water conservation, low maintenance plants, pervious walkway options, and rainwater collection.
- Partnership with the Riverside Nature Center to provide "UGRA 2nd grade Science Day" field trip to all Kerr County 2nd graders.
- Annual River Clean Up event and assistance with cleanups coordinated by other groups.
- Water Enhancement Cost Share Program provides additional reimbursement to landowners enrolled in USDA Natural Resources Conservation Service (NRCS) or TSSWCB brush management programs. Landowners in the Guadalupe River watershed in Kerr County can receive 25 percent of the amount reimbursed by NRCS or TSSWCB once they have completed brush management activities.
- Water and sediment control basin structures have been constructed at seven locations in the upper Guadalupe River watershed. The structures function to slow runoff during rain events to reduce flooding and sediment loading into the river.
- Rebates up to $500 are issued to Kerr County residents on their purchases of rainwater catchment system equipment.
- The Rainwater system Grant Program provides a matching grant reimbursement to fund rainwater catchment systems in Kerr County. The program is open to all nonprofit organizations, schools, and public entities interested in initiating a rainwater catchment system or expanding a current system in Kerr County. Applicants can request a maximum of 75 percent of the project cost up to $15,000.
- The Water Resources Preservation Grant program provides a cost share rebate to incentivize design and construction of stormwater management practices that reduce, infiltrate, filter, and delay stormwater runoff. Minimum rebate amount is $20,000 and the maximum is $150,000 per project. Eligible practices include bioretention, permeable pavement, rainwater harvesting, and vegetated filter strips.

- Kerr County Commissioners' Court formed the Kerr County Aggregate Production Operations (APO) Community Advisory Council in June 2021. The Committee brings aggregate production operators, businesses, residents, and local governing agencies together to the same table so that they can work toward common solutions and better outcomes for all. The Committee developed and adopted a voluntary guidance document that describes best management practices for sand and gravel mining operations to address several concerns including water consumption. The complete guidance document including Section B. Water Consumption can be accessed on the UGRA website: Kerr County Voluntary Guidance Document for Aggregate Production Operations.
- Additional opportunities to provide information to the public on water conservation are made available through presentations to students and adults, radio public service announcements, routine newspaper articles, and advertisements in local publications.

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APPENDIX 5A
RECOMMENDED AND ALTERNATE WATER MANAGEMENT STRATEGIES

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INTRODUCTION

Water Management Strategies described in this Appendix are proposed recommended projects to meet projected water-supply shortages in future decades, and projects of specific interest by water-user entities participating in this planning process. The strategy evaluation procedure is designed to provide a side-by-side comparison such that all strategies can be assessed based on the same quantifiable factors as shown in Chapter 5 Tables 5-2, 5-3 and 5-4. Specific factors considered in each Table were:

<u>Table 5-2</u>

- Quantity of new water produced.
- Chemical quality.
- Reliability of water supply.
- Impacts to water, agricultural, and natural resources.

<u>Table 5-3</u>

- Financial cost (total capital cost, annual cost, and cost per acre-foot).

<u>Table 5-4</u>

- Environmental impacts:
    - Environmental water needs.
    - Wildlife habitat.
    - Cultural resources.
    - Environmental water quality.
    - Inflows to bays and estuaries.

Qualitative and quantifiable impacts resulting from the implementation of projects are an important aspect of the overall analysis of the viability of water management strategies. The Tables above provide a coded ranking of impacts to designated required analysis categories. An explanation of the qualitative and quantifiable rankings listed in the Tables is provided in Appendix 5B. It is recognized that all strategies that require constructed infrastructure, including pipelines, will have either a temporary or permanent land disturbance on the footprint of the project.

Cost evaluations for all strategies include capital cost, debt service, and annual operating and maintenance (O&M) expenses. Capital costs are estimated based on September 2023 US dollars. The length of debt service is 20 years unless otherwise stated. An annual unit cost is also calculated based on the O&M cost per acre-foot of water supplied.

5A-1 WATER MANAGEMENT STRATEGIES FOR BANDERA COUNTY

5A 1.1 Water Management Strategies for the City of Bandera

The City of Bandera and many other residents of Bandera County rely on the Lower Trinity Aquifer for municipal, domestic, livestock, and irrigation water-supply needs, and the demand from the Lower Trinity is projected to increase as the population increases. Because the water level in the Lower Trinity has declined about 350 feet in City of Bandera wells since pumping started in the 1950s, there is concern that continued withdrawals from the Aquifer may negatively impact the Aquifer's ability to meet the long-term water-supply needs of the area.

Although the supply-demand analysis does not project a future water-supply deficit for the City of Bandera, the following water management strategies are recommended to enhance the reliability of the City's future water supply availability.

- (J-1) Water loss audit and main-line repair.
- (J-2) Reuse treated wastewater effluent for irrigation of public spaces.
- (J-3) Promote, design, and install rainwater harvesting systems on public buildings.
- (J-4) Additional Lower Trinity Aquifer well outside the current cone-of-depression and lay necessary pipeline **(ALTERNATE).**
- (J-5) Additional Middle Trinity Aquifer wells within City water infrastructure area.
- (J-6) Surface water acquisition, treatment and ASR.

The City of Bandera has been active in promoting water conservation during the current drought and has committed to using water conservation as a long-term water management strategy. Conservation practices that the City has adopted include tiered water rates; providing the public with water conservation information; meter change out program and water-line replacement program to reduce unaccounted for water loss. The City has also been working with residential and commercial water customers to identify BMPs that can be used to reduce water consumption as well as evaluating the potential for installing rainwater harvesting systems on public buildings. The City of Bandera has adopted the Bandera County River Authority and Groundwater District Drought Contingency Plan. The City is currently in Stage 4 of drought, which is considered critical conditions. During this stage, outdoor water use is prohibited, except for what is necessary for livestock. The implementation of various stages of drought over the past several years has reduced water use and heightened public awareness of the need to conserve water.

J-1 Water Loss Audit and Main-Line Repair

According to the 2022 TWDB Public Water System Water Loss Survey, the City of Bandera had real water losses (as opposed to apparent "paper" losses) of 36 acre-feet in 2022 (15 percent) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water-supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This strategy will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability and Cost - The strategy assumes five miles of six-inch diameter pipe will be replaced, at a total estimated project capital cost of $5,327,000. The strategy is estimated to generate a potential savings of five acre-feet of water per year throughout the planning period.

J-2 Reuse Treated Wastewater Effluent for Irrigation of Public Spaces

The City of Bandera has requested funding through the Texas Water Development Board to study the potential of using treated wastewater effluent for irrigation of public parks and athletic fields. The importance of this effort is that the treated wastewater effluent is a known constant and can provide a new source of water for these uses. All current public supplies come predominantly from the Lower Trinity Aquifer, and therefore a significant aquifer cone-of-depression has resulted underlying the City of Bandera and surrounding area. If demands can be reduced it will potentially have a positive impact on water levels within the Aquifer.

Quantity, Reliability, and Cost – The quantity and reliability of this source is known through current wastewater discharges allowed under the City's wastewater discharge permit. Average daily flow from the wastewater plant is approximately 277,000 gallons/day (310 acre-feet/year). Based on the positive recommendation from the feasibility study, construction of this project will include amending the current discharge permit, potentially upgrading the wastewater treatment plant, a pump station, storage tanks and piping to deliver water. Total estimated capital cost for this project is approximately $2,117,000.

J-3 Promote, Design, and Install Rainwater Harvesting Systems on Public Buildings

Rainwater harvesting is a practical and valuable method for supplying water for multiple uses including household, landscape, livestock and agricultural. A renewed interest in this approach is emerging due to escalating environmental and economic costs associated with the traditional centralized water systems or the drilling of wells. The State has devoted a considerable amount of attention to rainwater harvesting and has enacted many laws regulating this practice. Three specific pieces of legislation support the collection of rainwater: Texas Tax Code 151.355 which allows for a state sales tax exemption on rainwater harvesting equipment, Texas Property Code 202.007 prevents homeowners' associations from banning rainwater harvesting installations, and Texas House Bill 3391 which requires designs of new state buildings to include rainwater harvesting system technology.

The City of Bandera and the Bandera County River Authority and Groundwater District (BCRAGD) is actively involved in the conservation of water through rainwater harvesting. In 2013, Bandera High School was the recipient of the Texas Water Development Board's Texas Rain Catcher Award. This program is established to promote technology, educate the public, and to recognize excellence in the application of rainwater harvesting systems in Texas.

The City of Bandera, with the recommendation from the BCRAGD, has plans to develop a rainwater collection system utilizing rooftops located in the downtown area. This strategy assumes that the system will be gravity fed and used for local irrigation purposes. This project is designed to collect rainwater from two commercial sized roofs and store the water in fiberglass tanks at the respective locations. The strategy includes a fiberglass tank as opposed to a steel tank, since the steel tank would cost considerably more.

Quantity, Reliability, and Cost – This strategy will provide an additional one acre-foot per year. The total estimated capital cost for this project is approximately $83,000. This project will provide a firm supply of water even though some impact would be expected during drought conditions.

J-4 Additional Lower Trinity Aquifer Well Outside the Current Cone-of-Depression and Lay Necessary Pipeline (ALTERNATE)

The City of Bandera obtains its water from the Trinity Aquifer and serves a growing population. The projected population growth is expected to increase from 1,949 in 2030; to 2,152 by 2080. To keep pace with the growing water demands, the City of Bandera, with the recommendation from the (BCRAGD) has plans to develop additional groundwater from the Lower Trinity Aquifer.

The development of additional supplies from the Lower Trinity Aquifer includes one new well located approximately four miles north of town. It is assumed that the City will purchase the necessary property, costing approximately $10,000 per acre, along with the associated water rights and develop the infrastructure needed to pipe the water back to the City. This well will produce water from approximately 800 feet below the surface.

Quantity, Reliability, and Cost – The strategy supply is estimated at 403 acre-feet per year. The Lower Trinity Aquifer has shown that it can be considered reliable as a water supply if properly developed and is not compromised by additional demands. Care will need to be taken to find a suitable site for the new well to prevent any overlapping of existing aquifer cones-of-depression. The cost to develop a water well in the Lower Trinity Aquifer is significant, along with the necessary infrastructure to store and pump the water back to the City of Bandera. The total estimated capital cost for this project is approximately $7,067,000.

J-5 Additional Middle Trinity Aquifer Wells within City Water Infrastructure Area

The City of Bandera with the recommendation from BCRAGD has identified the Middle Trinity Aquifer as a potential source of supply for meeting future water demands. Currently, this source is not being used for municipal purposes. Development of this Aquifer may provide a source of water that could potentially reduce peak demands on existing wells in the Lower Trinity Aquifer.

The proposed two wells will be located near the Medina River where more recharge might be anticipated and will produce water from approximately 550 feet below the surface. This strategy assumes that the supply from the Middle Trinity Aquifer would require minimal treatment such as chlorine disinfection. In addition, this strategy assumes 1,500 feet of connection piping.

Quantity, Reliability, and Cost – The quantity of water available in the Middle Trinity Aquifer is less than that of the Lower Trinity Aquifer. However, the wells can be pumped at a sustainable rate that does not exceed the MAG allowable. The reliability of water from this source is expected to be approximately 50 gpm. However, the Middle Trinity Aquifer has not been developed for municipal water supply in Bandera. The two wells are expected to yield approximately 161 acre-feet per year. The cost to develop a municipal water well in the Middle Trinity Aquifer is anticipated to be less since the City will not have to drill as deep. Furthermore, this strategy assumes that the new wells will be located within the City limits, minimizing project costs associated with the amount of connection piping required to meet the existing distribution system. The total estimated capital cost for this project is approximately $1,115,000.

J-6 Surface Water Acquisition, Treatment and ASR

The City of Bandera has considered the feasibility of constructing a water treatment facility to treat surface water from the Medina River. As much of the treated water as is needed will go directly into customer distribution, with the excess being injected into existing public supply wells for future retrieval (ASR). A February 2023 study report (389) titled Aquifer Storage and Recovery Report: Longevity Assessment for the City of Bandera Water Wells was prepared for the Plateau Region Water Planning Group and can be accessed for more strategy detail.

Bandera County currently has a Water Supply Agreement with Bandera-Medina-Atascosa WCID #1 (BMA WCID#1) for the option of up to 5,000 acre-feet per year. The BMA WCID#1 owns Certificate of Adjudication CA-19-2130, which authorizes the District to divert up to 65,830 acre-feet per year for irrigation, municipal and industrial uses; up to 750 acre-feet per year specifically for domestic and livestock purposes; and up to 170 acre-feet per year specifically for municipal use.

Under CA-19-2130, BMA WCID#1 is authorized to divert water from Medina Lake and Diversion Dam. However, it is anticipated that the surface water purchased by Bandera County for local use and the potential ASR project will be diverted in the vicinity of the City of Bandera, upstream of Medina Lake. As a result, an amendment of the existing water right owned by BMA WCID#1 is required and the addition of an upstream diversion point will likely be subject to additional bypass requirements related to adopted Senate Bill 3 (SB 3) environmental flow standards.

Quantity, Reliability, and Cost – The reliability of the addition of an upstream river diversion was calculated with the official Run 3 version of the Water Availability Model (WAM) of the Guadalupe-San Antonio Basin dated October 2023, provided by the TCEQ. Assumptions of the Run 3 version include adherence to strict prior appropriation; maximum use and storage; no return flows; a hydrologic simulation period of 1934-1989; and application of downstream SB 3 environmental flow standards as adopted and implemented by the TCEQ. The version as received from the TCEQ includes updates for Lake Medina/Diversion Lake and the addition of channel loss factors to all main stem water rights in the Guadalupe and San Antonio River Basins. Based on these modeled characteristics, the average diversion available from the modeled upstream diversion over the historical period (1934-1989) is 4,761 acre-feet per year.

An initial facility will provide 500 acre-feet per year of treated water. As much as is needed will go directly into customer distribution, with the excess being injected into existing public supply wells. In 2040 the facility will increase capacity to 1,000 acre-feet per year, and in 2060 the capacity increases to 1,500 acre-feet per year. To be conservative, a diversion of 85 percent of the average WAM 3 supply or 3,100 acre-feet per year is assumed to be reliably available for planning purposes. It is anticipated that at least approximately 70 percent of the water injected is recoverable. The total estimated capital cost for this project is approximately $50,501,000.

5A 1.2 WATER MANAGEMENT STRATEGIES FOR BANDERA COUNTY FWSD #1

Bandera County Fresh Water Supply District #1 was created by the Bandera County Commissioners Court on April 16, 1961. It is the mission of the District to provide the best quality of water at the most reasonable rate. Bandera County FWSD #1 obtains their water supply from groundwater within the Trinity Aquifer by means of four groundwater wells.

Although the supply-demand analysis (Chapter 4) does not project a future water-supply deficit for Bandera County FWSD #1, the following water management strategies are recommended to enhance the reliability of the future water-supply availability for residents.

- (J-7) Public conservation education - Bandera County FWSD #1.
- (J-8) Additional groundwater well for Bandera County FWSD #1.

J-7 Public Conservation Education - Bandera County FWSD #1

Bandera County FWSD#1 is encouraged to emphasize conservation through public information programs. A total of one percent reduction in demand is anticipated, which will result in a water savings of approximately four acre-feet per year. The annual cost of this project in 2030 is estimated to be $876. The total capital cost for this strategy is estimated to be $5,342.

J-8 Additional Groundwater Well for Bandera County FWSD #1

This strategy assumes that one new water well be drilled in the Lower Trinity Aquifer, approximately 600 feet in depth. It is anticipated that the well will be cased with either 8- or 12-inch PVC or steel pipe. A 65-gpm electric submersible pump will be installed. In addition, a chlorinator for disinfection purposes will be installed and housed in a small building located on-site. The proposed wellsite will include a new 30,000-gallon groundwater storage tank and a dual pump station. A 6-inch water line will be installed to convey water from the well-head to the storage tank, and ultimately to the nearby potable water distribution system.

Quantity, Reliability, and Cost – The quantity of water from the Trinity Aquifer is deemed to be sufficient to meet future demands if a site outside of the existing cone-of-depression can be found. The Aquifer has shown that it can be considered reliable as a water supply if properly developed and is not compromised by additional water demands. It is anticipated that this strategy will provide an additional 100 acre-feet per year. The total estimated capital cost for this project is approximately $1,562,000.

5A 1.3 WATER MANAGEMENT STRATEGIES FOR BANDERA COUNTY-OTHER

Bandera County-Other has less than 19,000 in population, including individuals living outside of a named water user group. This compilation of users known as County-Other is self-supplied and relies predominately on the Trinity Aquifer for their water-supply needs, either on private wells or privately owned water-supply systems. In a few locations, the Edwards-Trinity (Plateau) Aquifer is a modest source of supply.

Although the supply-demand analysis does not project a future water-supply deficit for Bandera County-Other, the following water management strategies are recommended to enhance the reliability of the future water supply availability for Bandera County-Other.

- (J-9) Water loss audit and main-line repair for Bridlegate Subdivision.
- (J-10) Water loss audit and main-line repair for Flying L Ranch PUD.
- (J-11) Additional groundwater well - Medina WSC.
- (J-12) Drought management – San Antonio Basin.
- (J-13) Vegetative management – San Antonio Basin.
- (J-14) Additional groundwater wells to provide emergency supply near the volunteer fire Department **(ALTERNATE)**.
- (J-15) Drought management – Nueces Basin.

J-9 Water Loss Audit and Main-line Repair for Bridlegate Subdivision

According to the 2022 TWDB Public Water System Water Loss Survey, the Bridlegate Subdivision had a total water loss (as opposed to apparent “paper” losses) of seven acre-feet in 2022 (13 percent) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water-supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This strategy will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability and Cost - The strategy assumes two miles of six-inch diameter pipe will be replaced, at a total estimated project capital cost of $2,130,000. The strategy is estimated to generate a potential savings of one acre-foot of water per year throughout the planning period.

J-10 Water Loss Audit and Main-line Repair for Flying L Ranch PUD

According to the 2020 TWDB Public Water System Water Loss Survey, the Flying L Ranch PUD had a total water loss (as opposed to apparent “paper” losses) of 12 acre-feet in 2020 (19 percent) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water-supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This strategy will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability and Cost - The strategy assumes one mile of six-inch diameter pipe will be replaced, at a total estimated project capital cost of $1,065,000. The strategy is estimated to generate a potential savings of two acre-feet of water per year throughout the planning period.

J-11 Additional Groundwater Well – Medina WSC

This strategy assumes that one new water well be drilled in the Lower Trinity Aquifer, approximately 800 feet in depth. It is anticipated that the well will be cased with either 8- or 12-inch PVC or steel pipe. A 250-gpm electric submersible pump will be installed. In addition, a chlorinator for disinfection purposes will be installed and housed in a small building located on-site. The proposed well site will include a new 30,000-gallon groundwater storage tank and a dual pump station. A 6-inch water line will be installed to convey water from the well head to the storage tank, and ultimately to the nearby potable water distribution system.

Quantity, Reliability, and Cost – The quantity of water from the Trinity Aquifer is deemed to be sufficient to meet future demands if a site outside of the existing cone-of-depression can be found. The Aquifer has shown that it can be considered reliable as a water supply if properly developed and is not compromised by additional water demands. It is anticipated that this strategy will provide an additional 55 acre-feet per year. The total estimated capital cost for this project is approximately $2,129,000.

J-12 Drought Management – San Antonio Basin

The Bandera County River Authority and Groundwater District (BCRAGD) has implemented a drought management plan (see Chapter 7 Section 7.2.6.1) to aid in groundwater conservation during declared drought conditions. Stages are triggered by the U.S. Drought Monitor but can be adjusted at the discretion of the District when aquifer levels, rainfall and river flow conditions warrant. Drought stages are mandated pumping restrictions for permitted wells and recommended restrictions for exempt wells. This strategy recommends that the BCRAGD declare a minimum of Stage 2 (20-percent reduction) on specified wells in the Bandera County San Antonio River Basin to reduce aquifer supply demand by 20 percent. The resulting pumpage reduction will decrease water supply demand in the San Antonio Basin by: 441 acre-feet/year in 2030; 491 acre-feet/year in 2040; 516 acre-feet/year in 2050; 525 acre-feet/year in 2060; 533 acre-feet/year in 2070; and 537 acre-feet/year in 2080.

J-13 Vegetative Management – San Antonio Basin

Several invasive species have been recognized in the Plateau Region, as well as elsewhere in the State, that have a negative impact on surface water flow in springs, creeks, and rivers, as well as recharge to underlying aquifers. Species of major concern are Giant River Cane (*Arundo donax*) and Elephant Ears (*Colocasia esculenta*) in watersheds, and the encroachment of woody species such as Ashe-juniper and Mesquite. The PWPG has selected vegetative management as an appropriate water management strategy for several river basins within the Plateau Region. A more detailed description of this strategy is contained in Section 5.2.8 of this Chapter.

Reduced rainfall during drought-of-record conditions certainly reduces aquifer recharge potential. However, some rainfall (and thus recharge) still does occur. Research studies (see Chapter 5, Section 5.2.8) have documented potential recharge impacts resulting from vegetative management. Chapter 7, Section 7.1.1 defines drought-of-record conditions pertaining to rainfall in the Plateau Region as being an average of 20 percent (five inch) reduction in rainfall per year during the 1950’s drought and an average 40 percent (10 inch) reduction during more current years. Assuming the worst-case scenario of 40 percent reduction in precipitation will likewise result in 40 percent reduction in average recharge potential, the amount of supply produced for this strategy is 1,388 acre-feet per year.

J-14 Additional Groundwater Wells to Provide Emergency Supply near Volunteer Fire Department (ALTERNATE)

Bandera County River Authority & Groundwater District (BCRAGD) has plans to develop a Regional Project designed to offer relief to residents impacted by severe drought conditions, and to provide a source of water to be potentially used by Fire Departments for emergency firefighting. This strategy assumes that public supply wells will be drilled in strategic locations and outfitted with a 30,000-gallon storage tank per site, which will be connected to the wells by 500 feet of connection piping. In addition, this strategy will be monitored by the BCRAGD to document aquifer conditions, conduct scientific studies such as determining aquifer recharge from rainfall, DFC compliance and regional planning. It is estimated that two new wells will be drilled in the Lower Trinity Aquifer. One well will be drilled in Eastern Bandera County approximately 800 feet in depth, with a capacity of 75-gpm. The second well will be in Western Bandera County approximately 1,100 feet in depth, with a capacity of 100-gpm. The developed water will require minimal treatment such as chlorine disinfection for municipal purposes.

Quantity, Reliability, and Cost – It is anticipated that these two wells will yield a total of 189 acre-feet per year from the Lower Trinity Aquifer. The Aquifer has shown that it can be considered reliable as a water supply if properly developed and is not compromised by additional water demands. The cost to develop water in the Lower Trinity Aquifer is significant. The total estimated capital cost for this project is approximately $7,527,000.

J-15 Drought Management – Nueces Basin

The Bandera County River Authority and Groundwater District (BCRAGD) has implemented a drought management plan (see Chapter 7 Section 7.3.6.1) to aid in groundwater conservation during declared drought conditions. Stages are triggered by the U.S. Drought Monitor but can be adjusted at the discretion of the District when aquifer levels, rainfall and river flow conditions warrant. Drought stages are mandated pumping restrictions for permitted wells and recommended restrictions for exempt wells. This strategy recommends that the BCRAGD declare a minimum of Stage 2 (20-percent reduction) on specified wells in the Bandera County Nueces River Basin to reduce aquifer supply demand by 20 percent. The resulting pumpage reduction will decrease water supply demand in the Nueces Basin by 23 acre-feet/year in 2030; 26 acre-feet/year in 2040; 27 acre-feet/year in 2050; 28 acre-feet/year in 2060; 28 acre-feet/year in 2070; and 28 acre-feet/year in 2080.

5A 1.4 WATER MANAGEMENT STRATEGIES FOR BANDERA COUNTY IRRIGATION

Bandera County has approximately 957 acre-feet of irrigation shortage in the San Antonio River Basin over the planning horizon. Irrigation within the Plateau Region is generally limited in most of the counties due to arid conditions and lack of well-developed soils. Low well yields common throughout much of the Region also limit the development of large-scale irrigation. Bandera County generally irrigates less than 200 acres of land with Trinity Aquifer groundwater. In addition to groundwater, most of the diversions by water rights on both the Nueces River and the San Antonio River are used for irrigation purposes.

However, surface water is commonly very limited during drought conditions. The following water management strategies are recommended to enhance the reliability of the future water supply availability for the irrigation needs within Bandera County but will leave an unmet need of 806 acre-feet per year throughout the planning period.

- (J-16) Irrigation scheduling – San Antonio Basin.
- (J-17) Additional groundwater wells - San Antonio Basin.

J-16 Irrigation Scheduling

This strategy is intended for producers with an adequate supply of water throughout the growing season. It involves scheduling the time and amount of water that is applied to a crop based on the amount of water present in the crop root zone, the amount of water consumed by the crop since the last irrigation, and other considerations. Water savings are difficult to quantify and vary from year to year based on cropping practices, water quality, and quantity. It is estimated that 0.3 to 0.5 acre-feet of water per acre may be saved, according to Best Management Practices for Agricultural Water Users, found on the TWDB's website.

Quantity, Reliability and Cost - According to the 2022 U.S. Ag Census, Bandera County had 40 farms with irrigated land in 2022 and 10,060 acres of irrigated land, which gives an average of 252 acres per farm. Assuming that scheduling would conserve 0.3 acre-feet per acre this results in a conservation savings of approximately 76 acre-feet per farm. The reliability of this supply is low due to uncertainty associated with estimated implementation of BMPs. There is no cost associated with implementing this strategy.

J-17 Additional Groundwater Wells – San Antonio Basin

The Trinity Aquifer has been identified as a potential source of water to meet a portion of the irrigation shortages within the County. Water from this source is generally good. TDS levels increase as the depth to the Aquifer increases. The Trinity Aquifer is one of the most extensive and highly used groundwater sources in Texas. This strategy assumes that three new wells will be drilled to provide approximately 75 acre-feet per year. These wells will produce water from approximately 330 feet below the surface.

Quantity, Reliability, and Cost –The three new wells are assumed to supply an additional 75 acre-feet per year. The reliability of this supply is medium, based on competing demands. The total capital cost of this project is approximately $399,000.

5A 1.5 WATER MANAGEMENT STRATEGIES FOR BANDERA COUNTY LIVESTOCK

Bandera County has a total projected seven acre-feet per year of livestock water use shortage over the planning horizon. The water supply shortage occurs within the Nueces River Basin (20 acre-feet per year). All other river basins are projected to have a water supply surplus throughout the planning period. During times of prolonged drought, ranchers often reduce their stock inventory, which will naturally result in decreased supply demand.

Livestock within the County obtain supplies from both surface and groundwater sources. Surface water, such as local-supply tanks, is commonly used, but limited during drought. Groundwater from the Edwards-Trinity (Plateau) Aquifer and Trinity Aquifer are more reliable sources. The following water management strategies are recommended to enhance the reliability of the future water supply availability for livestock needs within Bandera County.

- (J-18) Livestock conservation – Nueces Basin.
- (J-19) Additional groundwater wells - Nueces Basin.

J-18 Livestock Conservation – Nueces Basin

Rotational grazing consists of subdividing grazing pastures and rotating livestock from one pasture to another on a regular interval. This allows the watershed, soils, and vegetation to recover from the stress of continuous livestock grazing. A study by Texas A&M AgriLife Research at Vernon (Ledbetter, 2017) found that changing to a multi-pasture rotational livestock management system reduced surface runoff and sediment load in the local stream by 39 and 34 percent, respectively. The study also found that subsurface flow increased by 48 percent, primarily due to increased infiltration and soil water storage associated with rotational grazing. This strategy assumes a conservative 20 percent reduction of the projected supply need, providing 13 acre-feet per year in a water supply savings for the Nueces River Basin. No capital cost is assigned to this strategy.

J-19 Additional Groundwater Wells – Nueces Basin

The Edwards-Trinity (Plateau) Aquifer has been identified as a potential source of water to meet the livestock shortages within the County and is a recommended strategy. Water from this source ranges from fresh to slightly saline in the outcrop areas, and brine water in subsurface portions. This strategy assumes that four new 20 gpm wells will be drilled to approximately 860 feet below the surface.

Quantity, Reliability, and Cost – The four new wells are assumed to supply an additional eight acre-feet per year, with a medium to high reliability based on competing demands. The total cost of this project will be approximately $671,000.

5A-2 WATER MANAGEMENT STRATEGIES FOR EDWARDS COUNTY

5A 2.1 WATER MANAGEMENT STRATEGIES FOR THE CITY OF ROCKSPRINGS

The City of Rocksprings is the county seat for Edwards County, named from the natural springs that occur within the porous limestone rocks in the area. The City and many other residents of Edwards County rely on the Edwards-Trinity (Plateau) Aquifer for municipal, domestic, livestock and irrigation water supply needs. Some local surface water is used by livestock. However, much of the supply from these sources is nearly fully developed for current use.

The City of Rocksprings has no projected water supply deficit for this planning cycle. The following water management strategies are recommended to enhance the reliability of the City's future water-supply availability.

- (J-20) Public Conservation Education.
- (J-21) Water loss audit and main-line repair.
- (J-22) Additional Groundwater Wells.

J-20 Public Conservation Education

The City of Rocksprings is encouraged to emphasize conservation through public information programs. A total of one percent reduction in demand is anticipated, which will result in a water savings of approximately two acre-feet per year. The annual cost of this project in 2030 is estimated to be $1,148. The total capital cost for this strategy is estimated to be $5,555.

J-21 Water Loss Audit and Main-Line Repair

According to the 2022 TWDB Public Water System Water Loss Survey, the City of Rocksprings had a total water loss (as opposed to apparent "paper" losses) of 32 acre-feet in 2022 (15 percent) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water-supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This strategy will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability and Cost - The strategy assumes two miles of six-inch diameter pipe will be replaced, at a total estimated project capital cost of $2,130,000. The strategy is estimated to generate a potential savings of five acre-feet of water per year throughout the planning period.

J-22 Additional Groundwater Wells

The City of Rocksprings has recently completed the construction of two new Edwards-Trinity (Plateau) Aquifer wells located approximately six blocks west from the existing overhead storage facility. The City will need to install approximately 500 feet of connection pipe to connect to the wells. This strategy assumes that the new wells will produce water approximately 480 feet below the surface, providing an estimated 121 acre-feet per year. Minimal advance treatment such as chlorine disinfection is required for municipal use.

Quantity, Reliability, and Cost – The two new wells, when brought online, are assumed to supply an additional 121 acre-feet per year. The reliability of this supply is medium to high, based on competing demands. The total capital cost of this project is approximately $1,020,000.

5A 2.2 WATER MANAGEMENT STRATEGIES FOR EDWARDS COUNTY-OTHER

Edwards County-Other has less than 550 in population, including individuals living outside of a named water user group. This compilation of users known as County-Other is self-supplied and relies predominately on the Edwards-Trinity (Plateau) Aquifer for their water-supply needs, either on private wells or privately owned water-supply systems. In a few locations, the Nueces Alluvium Aquifer is a modest source of supply.

Although the supply-demand analysis does not project a future water-supply deficit for Edwards County-Other, the following water management strategies are recommended to enhance the reliability of the future water supply availability for Edwards County-Other.

- (J-23) Additional groundwater well and RO treatment (Barksdale WSC).
- (J-24) Vegetative management – Nueces Basin.

J-23 Additional Groundwater Well and RO Treatment (Barksdale WSC)

Barksdale WSC with the recommendation from Real-Edwards Groundwater Conservation and Reclamation District has plans to drill one additional well in the Nueces River Alluvium Aquifer to help supplement the existing water system. This strategy assumes that the necessary groundwater pumping authorization and property will be obtained for the development of one new well, located a sufficient distance from the other municipal wells in the system to prevent overlapping cones-of-depression. This well is expected to maintain minimum production of 34-gpm. The new well will be drilled at a depth of 50 feet. In addition, this strategy includes 300 feet of six-inch connection pipeline and a reverse osmosis wellhead filter.

Quantity, Reliability, and Cost – The quantity of water from this source is expected to provide up to 54 acre-feet per year. Sufficient groundwater is available from the Nueces River Alluvium Aquifer without causing excessive water-level declines; however, some impact might be expected in a severe drought. The total capital cost for this project is estimated at $317,000.

J-24 Vegetative Management

Several invasive species have been recognized in the Plateau Region, as well as elsewhere in the State, that have a negative impact on surface water flow in springs, creeks, and rivers, as well as recharge to underlying aquifers. Species of major concern are Giant River Cane (Arundo donax) and Elephant Ears (Colocasia esculenta) in watersheds, and the encroachment of woody species such as Ashe-juniper and Mesquite. The PWPG has selected vegetative management as an appropriate water management strategy for several river basins within the Plateau Region. A more detailed description of this strategy is contained in Section 5.2.8 of this Chapter.

Reduced rainfall during drought-of-record conditions certainly reduces aquifer recharge potential. However, some rainfall (and thus recharge) still does occur. Research studies (see Chapter 5, Section 5.2.8) have documented potential recharge impacts resulting from vegetative management.

Chapter 7, Section 7.1.1 defines drought-of-record conditions pertaining to rainfall in the Plateau Region as being an average of 20 percent (five inch) reduction in rainfall per year during the 1950's drought and an average 40 percent (10 inch) reduction during more current years. Assuming the worst-case scenario of 40 percent reduction in precipitation will likewise result in 40 percent reduction in average recharge potential, the amount of supply produced for this strategy is 87 acre-feet per year.

5A 2.3 WATER MANAGEMENT STRATEGIES FOR EDWARDS COUNTY IRRIGATION

Edwards County has approximately 15 acre-feet of irrigation shortage in the Rio Grande River Basin over the planning horizon. Irrigation within the Plateau Region is generally limited in most of the counties due to arid conditions and lack of well-developed soils. Low well yields common throughout much of the Region also limit the development of large-scale irrigation. Edwards County, like many other counties within the Hill Country, is prone to extreme heat, persistent drought, and ever-growing demand of water.

The following water management strategies are recommended to enhance the reliability of the future water supply availability for the irrigation needs within Edwards County.

- (J-25) Irrigation scheduling – Rio Grande Basin.

J-25 Irrigation Scheduling (Rio Grande Basin)

This strategy is intended for producers with an adequate supply of water throughout the growing season. It involves scheduling the time and amount of water that is applied to a crop based on the amount of water present in the crop root zone, the amount of water consumed by the crop since the last irrigation, and other considerations. Water savings are difficult to quantify and vary from year to year based on cropping practices, water quality, and quantity. It is estimated that 0.3 to 0.5 acre-feet of water per acre may be saved, according to Best Management Practices for Agricultural Water Users, found on the TWDB's website.

Quantity, Reliability and Cost - According to the 2022 U.S. Ag Census, Edwards County had 17 farms with irrigated land in 2022 and 215,704 acres of irrigated land, which gives an average of 12,688 acres per farm. Assuming that scheduling would conserve 0.3 acre-feet per acre this results in a conservation savings of approximately 3,806 acre-feet per farm. The reliability of this supply is low due to uncertainty associated with estimated implementation of BMPs. There is no cost associated with implementing this strategy.

5A 2.4 WATER MANAGEMENT STRATEGIES FOR EDWARDS COUNTY LIVESTOCK

Edwards County has a total projected water-supply surplus of 34 acre-feet per year throughout the planning period. However, within the Nueces River Basin, livestock has a projected shortage of 53 acre-feet in each decade throughout the planning horizon. During times of prolonged drought, ranchers often reduce their stock inventory, which will naturally result in decreased supply demand.

Livestock within the County obtain supplies from both surface and groundwater sources. Surface water, such as local-supply tanks, is commonly used, but limited during drought. Groundwater from the Edwards-Trinity (Plateau) Aquifer is a more reliable source. The following water management strategies are recommended to enhance the reliability of the future water supply availability for livestock needs within Edwards County.

- (J-26) Livestock conservation – Nueces Basin.

J-26 Livestock Conservation – Nueces Basin

Rotational grazing consists of subdividing grazing pastures and rotating livestock from one pasture to another on a regular interval. This allows the watershed, soils, and vegetation to recover from the stress of continuous livestock grazing. A study by Texas A&M AgriLife Research at Vernon (Ledbetter, 2017) found that changing to a multi-pasture rotational livestock management system reduced surface runoff and sediment load in the local stream by 39 and 34 percent, respectively. The study also found that subsurface flow increased by 48 percent, primarily due to increased infiltration and soil water storage associated with rotational grazing. This strategy assumes a conservative 20 percent reduction of the projected supply need, providing 51 acre-feet per year in a water supply savings for the Nueces River Basin. No capital cost is assigned to this strategy.

5A 2.5 WATER MANAGEMENT STRATEGIES FOR EDWARDS COUNTY MINING

Edwards County has approximately eight acre-feet of mining water supply shortage over the planning horizon. Local surface water in conjunction with groundwater from the Edwards-Trinity (Plateau) Aquifer, provide the water needed for industrial use within the County. The following water management strategies are recommended to enhance the reliability of the future water supply availability for the mining water-supply shortages within Edwards County.

- (J-27) Mining Conservation (Nueces Basin).
- (J-28) Additional groundwater well (Nueces Basin).

J-27 Mining Conservation (Nueces Basin)

Mining groundwater use in the Plateau Water Planning Area is primarily associated with oil and gas production. Water is needed for well drilling activities, formation fracing, and sand (proppant) mining plants. The PWPG encourages the use of alternative water sources when and where it is economically feasible to do so. For conservation of freshwater resources associated with fracing, on-site treatment of produced and/or flowback water allows for reuse of the water stream. There are numerous third-party vendors who offer mobile produced water recycling systems.

In 2018, approximately 10 percent of fracwater supply in the Permian Basin was recycled produced water. Conservation of 15 percent of Edwards County mining needs (Nueces Basin) would reduce mining needs by two acre-feet in all decades throughout the planning period. No capital cost is assigned to this project.

J-28 Additional Groundwater Well (Nueces Basin)

The Edwards-Trinity (Plateau) Aquifer has been identified as a potential source of water to meet the mining water supply shortages within the County. The Aquifer consists of lower Cretaceous age, saturated limestones and dolomites of the Edwards and Trinity Groups that occur in the Edwards Plateau. Water from this source can be variable, with water quality ranging from fresh to slightly saline in the outcrop areas, and brine water in subsurface portions. Reported well yields commonly range from less than 50-gpm where saturated thickness is thin; to more than 1,000-gpm where large capacity wells are completed in jointed and cavernous limestone. This strategy assumes that one new well will be drilled to produce water from approximately 600 feet below the surface and produce at a rate of 40-gpm.

Quantity, Reliability, and Cost –The one new well is assumed to supply an additional 16 acre-feet per year, with a reliability of medium to high based on competing demands. The total capital cost of this project is approximately $154,000.

5A-3 WATER MANAGEMENT STRATEGIES FOR KERR COUNTY

5A 3.1 WATER MANAGEMENT STRATEGIES FOR THE CITY OF KERRVILLE

The City of Kerrville has developed a conjunctive-use policy for both surface water and groundwater and passed a comprehensive Water Management Plan in early 2004 (updated 2018). The policy specifies that: (1) surface water will be used to the maximum extent that it is available, (2) groundwater will be a supplemental source of supply, and (3) water consumption will be reduced through conservation.

The TCEQ Guadalupe River WAM 3 drought-of-record analysis yields 150 acre-feet per year of surface water from the Guadalupe River for municipal use and 75 acre-feet per year for irrigation as reliable for the City of Kerrville. For planning purposes, the City proposes to use this estimate of available surface water, even though the estimate is significantly less than the permitted amount based on availability during a drought-of-record. Kerrville will develop additional surface and groundwater supplies, storage options or modifications to the existing permits, and expansion of the aquifer storage and recovery (ASR) system if it can be shown that there are periods when the City will not be able to use the permitted water from the Guadalupe River.

The City of Kerrville has been operating an ASR system for the past several years. In this system, a portion of treated Guadalupe River surface water is injected into the Lower Trinity Aquifer during months of water surplus and recovered from the Aquifer for subsequent use during dry summer months. Currently, the ASR has two wells that serve for both injection and recovery. The capacity of the storage in the ASR is virtually unlimited, but the rates of injection and recovery are limited to 1 mgd in each of the two wells. A third well is in planning stages. As of December 2018, the total storage in the ASR was over 950 million gallons (2,915 acre-feet).

Assuming that a drought-of-record starts immediately, the maximum reliable supply for the City of Kerrville is 150 acre-feet per year using the volume stored in the Aquifer as of June 2010. Permit 1996 would provide an additional 150 acre-feet per year for municipal use, for a total of 300 acre-feet per year. However, the ASR storage does not recover quickly, and if there are multiple drought years, the ASR may not have enough storage for a reliable supply to cover the entire drought period. Therefore, a reliable surface water supply of 150 acre-feet per year for the City of Kerrville is recommended.

Based on current groundwater availability estimates, the firm yield of the Lower Trinity Aquifer is estimated at 4,250 acre-feet per year in the Kerrville area. The City of Kerrville uses approximately 3 mgd, or 3,360 acre-feet per year as an available groundwater supply during a drought year. The City continues to rely on the Lower Trinity Aquifer as a dependable source of water. Through the City’s conjunctive use policy, groundwater is reserved for meeting peak demand in a normal year and base demand in a drought year. For planning purposes, the estimates of available groundwater are 5 mgd (5,600 acre-feet per year) for peak demand and 3 mgd (3,360 acre-feet per year) for average demand.

The City has identified the possibility of modifying its own existing water permits. Currently the City’s ability to divert under its existing permits is dependent on whether more senior water right holders exercise their rights and is also affected by the City’s Special Conditions written into its permits. If the City had more reliability from the Guadalupe River and more latitude in its ability to divert during certain months of the year, the City could more fully utilize its ASR facility.

The City of Kerrville's water treatment capacity also limits its utilization of its ASR facility. The City needs excess treatment capacity to treat and store 4 mgd during periods of higher streamflow; the current ASR system is limited to 2 mgd. The City has included the necessary project to increase the ASR system to 4 mgd in the ten-year capital improvement program.

The City is currently exploring the potential of a second Ellenburger Aquifer to provide additional water supply.

The availability of water will become a factor limiting the growth of both Kerrville and Kerr County. Currently, the supply-demand analysis for the City of Kerrville projects a water-supply deficit of 1,445 acre-feet per year in 2030; increasing to 3,231 acre-feet per year by 2080. Water management strategies that the City can consider as possible future sources of supply include the bulleted items below.

- (J-29) Increase wastewater reuse.
- (J-30) Water loss audit and main-line repair for City of Kerrville.
- (J-31) Additional Ellenburger Aquifer groundwater well.
- (J-32) Increasing water treatment and ASR capacity.

J-29 Increase Wastewater Reuse

The City of Kerrville has completed construction of a 98-million-gallon detention pond at the City's existing WWTP to store treated effluent for reuse purposes. The design of this project is to also include a second detention pond to be constructed later when water demands warrant its construction. This strategy focuses solely on the construction of the second pond as a means of expanding the wastewater reuse system capacity.

Quantity, Reliability, and Cost – The quantity and reliability of water from this source is expected to be approximately 2,500 acre-feet per year. The reliability of this source is high. The total capital cost is approximately $23,355,000.

J-30 Water Loss Audit and Main-line Repair for City of Kerrville

According to the 2022 TWDB Public Water System Water Loss Survey, the City of Kerrville had a total water loss (as opposed to apparent "paper" losses) of 416 acre-feet in 2022 (10 percent) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water-supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This strategy will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability and Cost - The strategy assumes 27 miles of six-inch diameter pipe will be replaced, at a total estimated project capital cost of $28,757,000. The strategy is estimated to generate a potential savings of 42 acre-feet of water per year throughout the planning period.

J-31 Additional Ellenburger Aquifer Groundwater Well

This strategy assumes that one new water well will be drilled in the Ellenburger-San Saba Aquifer, approximately 1,150 feet in depth. It is anticipated that the well will be cased with either 8- or 12-inch PVC or steel pipe. A 600-gpm electric submersible pump will be installed. In addition, a chlorinator for disinfection purposes will be installed and housed in a small building located on-site. The proposed well site will include a new 30,000-gallon groundwater storage tank and a dual pump station. An 8-inch water line will be installed to convey water from the wellhead to the storage tank, and ultimately to the nearby potable water distribution system.

The first well within the Ellenburger Aquifer produced favorable results. A second test well will be drilled soon within the City of Kerrville to determine its viability as a municipal source for the City. If the results from this second well are favorable, the City will likely proceed with this strategy.

Quantity, Reliability, and Cost – It is anticipated that this strategy will provide an additional 1,156 acre-feet per year. The total estimated capital cost for this project is approximately $38,542,000.

J-32 Increasing Water Treatment and ASR Capacity

The City of Kerrville is planning on expanding its existing water treatment plant from its current capacity of 5 mgd to 7 mgd, and the ASR pumping and storage capacity of 2 mgd to 4 mgd. The capacity of the storage in the ASR is virtually unlimited, but the rates of injection and recovery are limited to 1 mgd in each of the two wells. A third and fourth well are in planning stages. As of December 2015, the total storage in the ASR was 600 million gallons (1,841 acre-feet).

The City is also evaluating the possibility of treating wastewater to drinking water standards and storing it in the ASR system. Wastewater is one of the most reliable sources of water during a drought and thus must be considered as a possible water supply. If it were decided to proceed with this project the City would need an additional 2-3 mgd of ASR capacity.

The City’s current water treatment capacity limits its utilization of its ASR facility. The City has identified the need for an additional 2 mgd of treatment capacity to take care of peak use; take advantage of periods when higher stream flows occur in the Guadalupe River; and thus, fully utilize its ASR. The increased storage capacity provided by the expanded ASR operation will make available water supplies more reliable. However, during drought-of-record conditions, water available from the upper Guadalupe River may be limited or nonexistent. Treated Guadalupe River water is injected into the aquifer during non-drought conditions when surface water is plentiful and is retrieved later as a supply source during drought-of-record conditions when surface water is scarce.

Quantity, Reliability, and Cost – The treated supply made available through this strategy is estimated to be 3,360 acre-feet per year. Because of the uncertainty involved with the development of this source for municipal use, the reliability of this strategy is considered moderate. It is anticipated that at least, approximately 70 percent of the water injected is recoverable. The total capital cost is estimated at $21,621,000.

5A 3.2 WATER MANAGEMENT STRATEGIES FOR KERRVILLE SOUTH WATER

Kerrville South Water has a projected water supply deficit beginning in 2030 of 70 acre-feet per year, increasing to 173 acre-feet per year by 2080.

The following water management strategy is recommended to enhance the reliability of the future water supply availability for Kerrville South Water.

- (J-33) Additional groundwater wells.

J-33 Additional Groundwater Well

This strategy assumes that two new water wells will be drilled in the Lower Trinity Aquifer, approximately 600 feet in depth. It is anticipated that the wells will be cased with either 8- or 12-inch PVC or steel pipe. A 65-gpm electric submersible pump will be installed. In addition, a chlorinator for disinfection purposes will be installed and housed in a small building located on-site. The proposed wellsite will include a new 30,000-gallon groundwater storage tank and a dual pump station. A 6-inch water line will be installed to convey water from the well-head to the storage tank, and ultimately to the nearby potable water distribution system.

Quantity, Reliability, and Cost – The quantity of water from the Trinity Aquifer is deemed to be sufficient to meet future demands if a site outside of the existing cone-of-depression can be found. The Aquifer has shown that it can be considered reliable as a water supply if properly developed and is not compromised by additional water demands. It is anticipated that this strategy will provide an additional 200 acre-feet per year. The total estimated capital cost for this project is approximately $2,209,000.

5A 3.3 WATER MANAGEMENT STRATEGIES FOR KERR COUNTY-OTHER

Kerr County-Other has a projected population of 20,501, excluding Kerrville and Kerrville South, in 2030, increasing to 25,245 by 2080. This compilation of users known as County-Other is self-supplied and relies predominately on groundwater from the Trinity Aquifer for their water supply needs. Although Kerr County-Other as a total, has a projected water supply surplus throughout the planning period, a small water supply deficit does exist within the Colorado Basin of approximately 79 acre-feet per year beginning in 2030, increasing to 101 acre-feet per year by 2080. This shortage is spread over the entire County. The rural population is however, concentrated in the eastern portion of the County.

Kerr County Commissioners' Court in partnership with the Upper Guadalupe River Authority (UGRA) has plans to develop several Eastern Kerr County Regional Water Supply projects to better serve expanding rural areas. These projects will offer reliable and sustainable sources of water for the growing water demands of numerous small utilities in the service region including Center Point and Center Point Taylor System.

Conservation will be a key factor in developing eastern Kerr County water needs in the future. The mission of UGRA is to "protect the health of the Guadalupe River watershed in Kerr County by managing water quality and water quantity, promoting stewardship, and providing services to support the communities."

The following water management strategies are recommended to enhance the reliability of the future water supply availability for Kerr County-Other.

- (J-34) Eastern Kerr County Regional Water Supply Project.
- (J-35) Purchase water from EKCRWSP – Center Point.
- (J-36) Purchase water from EKCRWSP – Center Point Taylor System.
- (J-37) Water loss audit and main-line repair for Community Water Group WSC.
- (J-38) Purchase water from EKCRWSP – Colorado Basin.
- (J-39) Vegetative management - Guadalupe Basin.

J-34 Eastern Kerr County Regional Water Supply Project

Population growth in eastern Kerr County continues to increase, creating genuine concerns pertaining to the water availability needed to meet these growing demands. Kerr County Commissioners' Court (KCCC) in partnership with the Upper Guadalupe River Authority (UGRA) has plans to develop several Eastern Kerr County Regional Water Supply Projects (EKCRWSP) to provide for conjunctive use of surface water and groundwater in high density growth areas of eastern Kerr County outside of the area serviced by the City of Kerrville. A facility plan was completed in 2010 utilizing an EDAP grant from the TWDB for a wholesale surface water supply. Total capital cost for all projects associated with this regional strategy is $156,421,000. UGRA is the sponsor for this regional project.

The *2026 Plateau Region Water Plan* projects only a limited amount of water-supply shortage for the rural Colorado River Basin portion of Kerr County at large; however, it is recognized that a greater percentage of the rural population is concentrated in the eastern portion of the County (see Chapter 2, Figure 2-3). To prepare for this concentrated water supply need the following water management projects are recommended to develop a regional water management strategy and enhance the reliability of the future water supply availability for the Kerr County-Other category.

- Project 1. Construction of an Ellenburger Aquifer water supply well.
- Project 2a. Construction of an off-channel surface water storage.
- Project 2b. Construction of surface water treatment facilities and transmission line.
- Project 3. Construction of ASR facilities.
- Project 4a. Trinity aquifer wellfield.
- Project 4b. Construction of a desalination plant.

Project 1. Ellenburger Aquifer Water Supply Well

This strategy considers a new water supply well providing water to the Eastern Kerr County Regional Project. The single well will be drilled to a depth of approximately 1,000 feet and will tap the Ellenburger Aquifer. This Aquifer has been identified as a viable source for Kerr County and is also a significant groundwater source for the City of Fredericksburg immediately to the north in Gillespie County. Subsurface geology suggests that there is a strong potential that usable groundwater will be encountered in the Ellenburger in northern Kerr County. Groundwater supplies produced from this well will be routed to the EKCRWSP distribution network or, if water quality treatment is necessary, to the desalination facility discussed in Project 2b.

Quantity, Reliability, and Cost – The Ellenburger Aquifer has been identified as a viable source. For this *Plan*, one new well will be drilled at a depth of 1,000 feet below the surface to provide an additional 108 acre-feet per year of water. This strategy includes two miles of six-inch diameter transmission line. Minimal treatment, such as chlorine disinfection, will be required for municipal purposes. The total estimated capital cost for this project is $906,000.

Project 2a. Construction of an Off-Channel Surface Water Storage

This Regional Project provides for the securing of one or more off-channel ground storage facilities. The strategy assumes that the facility will be lined with impervious material to prevent subsurface seepage loss. Guadalupe River water will be captured during excessive flow episodes. Following a period to allow for settling of sediment, the captured water will be diverted for treatment to drinking water quality to a facility site near the Community of Center Point (Project 2b). Water supply generated from this project will be combined with water supplies generated in all projects that make up Strategy J-34 for distribution to the public.

Quantity, Reliability, and Cost – The reliability of the river diversion was calculated with the official Run 3 version of the Water Availability Model (WAM) of the Guadalupe-San Antonio Basin dated October 2023, provided by the TCEQ. Assumptions of the Run 3 version include adherence to strict prior appropriation; maximum use and storage; no return flows; a hydrologic simulation period of 1934-1989; and application of downstream Senate Bill 3 environmental flow standards as adopted and implemented by the TCEQ.

The volume of water this strategy will produce is estimated to average 1,121 acre-feet per year, which will generally only occur during high river flow episodes. During drought-of-record periods, the supply is likely unavailable. Because of the uncertainty involved with the development of this source for municipal use, the reliability of this strategy is considered moderate by itself; however, in combination with other more reliable supplies the project becomes more meaningful.

Total estimated capital cost for this project is $39,053,000, which includes 1,500-acre land purchase and survey cost of $11,049,000.

Project 2b. Construction of Surface Water Treatment Facilities and Transmission Line

The construction of a surface water treatment facility to serve the unincorporated community of Center Point and other rural areas in eastern Kerr County includes a 1.8 mgd surface water treatment plant, an intake structure and pumping station, a 500,000-gallon elevated storage tank, and an assumed five miles of 10-inch diameter transmission line. Water supply sources for this facility are generated through Project 2a and possibly Project 1.

Quantity, Reliability, and Cost – In total, this strategy will provide treatment capacity for up to 1,121 acre-feet per year of water. The new supply of water will go directly into customer distribution. The total estimated capital cost for this project is $48,636,000. Treated supplies more than those that are of immediate use can be made available for storage in an ASR project (Project 3).

Project 3. Construction of ASR Facility

The feasibility of constructing an ASR facility to provide additional water supplies to the eastern portion of Kerr County was evaluated by LBG-Guyton Associates and Freese and Nichols, Inc. during the 2011 planning period (*Water Rights Analysis and ASR Feasibility in Kerr County, 2010*.

Quantity, Reliability, and Cost – This strategy evaluation assumed a facility site near the Community of Center Point. This strategy assumes that 1,124 acre-feet per year of excess treated water from the Project 2b water treatment facility would be injected into the Lower Trinity Aquifer and recovered during times of supply shortage. It is anticipated that at least, approximately 70 percent of the water injected is recoverable. The cost to construct and equip ASR wells capable of both injection and withdrawal is approximately $1,881,000. Because of the uncertainty involved with the development of this source for municipal use, the reliability of this strategy is considered moderate.

Project 4a. Trinity Aquifer Wellfield

Part of the Regional Project is to develop a wellfield to provide a water supply to the densely populated rural areas of Eastern Kerr County. This strategy assumes four wells will be drilled in the Trinity Aquifer to provide an additional 860 acre-feet per year. These wells would produce water from 530 feet below the surface. This strategy assumes a five-mile, 10-inch diameter transmission line will transport the water from the wells to the distribution center. Minimal treatment, such as chlorine disinfection, will be required for municipal purposes. In addition, advanced treatment will be necessary for municipal purposes due to anticipated water quality issues. The wells must be permitted by the Headwaters Groundwater Conservation District and withdrawals must not exceed the Trinity Aquifer MAG limit.

Quantity, Reliability, and Cost – The quantity and reliability of water from this source is expected to be approximately 200 gpm. For this *Plan*, the four new wells are assumed to supply an additional 860 acre-feet per year, beginning in the 2040 decade. The Trinity Aquifer has shown that it can be considered reliable as a water supply if properly developed and is not compromised by additional water demands. The total estimated capital cost for this project is approximately $13,067,000.

Project 4b Construction of a Desalination Plant

This strategy is contingent on Project 4a. Due to anticipated water quality issues (radon and sulfides) from the groundwater obtained in a newly developed well field or from an Ellenburger Aquifer supply well, advanced treatment will be necessary for municipal purposes. The brine concentrate from the wells will be disposed of using an evaporation pond.

Quantity, Reliability, and Cost –It is assumed that a 1.2 mgd brackish desalination treatment unit (for treatment of elevated TDS levels) as well as a simple filtration unit (for treatment of elevated radon and sulfides) would be necessary to treat the water for municipal use. It is anticipated that this strategy would provide an additional 860 acre-feet per year of water, beginning in the 2040 decade. The reliability of water from this source is expected to be medium to high based on competing demands. The total estimated capital cost for this project is $52,888,000.

J-35 Purchase Water from EKCRWSP – Center Point

Center Point is one of several small community utilities in Easter Kerr County that is expected to benefit from the construction of the Eastern Kerr County Regional Water Supply Project (Strategy J-34). Water supplies provided by the Project are derived from multiple sources and will be more reliable than existing individual sources. Although Center Point is not projecting a future water supply deficit, the community will likely derive all its supply (11 acre-feet per year) from the Project in the future. The annual supply purchase cost is estimated at $1,091 per acre foot for a total annual cost of $12,000.

J-36 Purchase Water from EKCRWSP – Center Point Taylor System

The Center Point Taylor System is one of several small community utilities in Easter Kerr County that is expected to benefit from the construction of the Eastern Kerr County Regional Water Supply Project (Strategy J-34). Water supplies provided by the Project are derived from multiple sources and will be more reliable than existing individual sources. Although the Center Point Taylor System is not projecting a water supply deficit, the utility will likely derive all its supply (43 acre-feet per year) from the Project in the future. The annual supply purchase cost is estimated at $1,140 per acre foot for a total annual cost of $49,000.

J-37 Water Loss Audit and Main-line Repair for Community Water Group WSC

According to the 2020 TWDB Public Water System Water Loss Survey, the Community Water Group WSC had a total water loss (as opposed to apparent “paper” losses) of six acre-feet in 2020 (22 percent) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water-supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This strategy will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability and Cost - The strategy assumes one mile of six-inch diameter pipe will be replaced, at a total estimated project capital cost of $1,065,000. The strategy is estimated to generate a potential savings of one acre-foot of water per year throughout the planning period.

J-38 Purchase Water from EKCRWSP – Colorado Basin

Kerr County-Other is comprised of several small community utilities in Easter Kerr County that are expected to benefit from the construction of the Eastern Kerr County Regional Water Supply Project (Strategy J-34). Water supplies provided by the Project are derived from multiple sources and will be more reliable than existing individual sources. Utilities within County-Other will likely derive all its supply (102 acre-feet per year) from the Project in the future. The annual supply purchase cost is estimated at $1,137 per acre foot for a total annual cost of $116,000.

J-39 Vegetative Management – Guadalupe Basin

Several invasive species have been recognized in the Plateau Region, as well as elsewhere in the State, that have a negative impact on surface water flow in springs, creeks, and rivers, as well as recharge to underlying aquifers. Species of major concern are Giant River Cane (Arundo donax) and Elephant Ears (Colocasia esculenta) in watersheds, and the encroachment of woody species such as Ashe-juniper and

Mesquite. The PWPG has selected vegetative management as an appropriate water management strategy for several river basins within the Plateau Region. A more detailed description of this strategy is contained in Section 5.2.8 of this Chapter.

Reduced rainfall during drought-of-record conditions certainly reduces aquifer recharge potential. However, some rainfall (and thus recharge) still does occur. Research studies (see Chapter 5, Section 5.2.8) have documented potential recharge impacts resulting from vegetative management. Chapter 7, Section 7.1.1 defines drought-of-record conditions pertaining to rainfall in the Plateau Region as being an average of 20 percent (five inch) reduction in rainfall per year during the 1950's drought and an average 40 percent (10 inch) reduction during more current years. Assuming the worst-case scenario of 40 percent reduction in precipitation will likewise result in 40 percent reduction in average recharge potential, the amount of supply produced for this strategy is 131 acre-feet per year.

5A 3.4 WATER MANAGEMENT STRATEGIES FOR KERR COUNTY IRRIGATION

Kerr County has a projected water supply deficit in the Colorado Basin of 97 acre-feet per year throughout the planning period, and three acre-feet per year of a water supply deficit in the San Antonio Basin throughout the planning period. Irrigation within the Plateau Region is generally limited in most of the counties due to arid conditions and lack of well-developed soils. Low well yields common throughout much of the Region also limit the development of large-scale irrigation. Kerr County, like many other counties within the Hill Country, is prone to extreme heat, persistent drought, and ever-growing demand of water.

The following water management strategies are recommended to enhance the reliability of the future water supply availability for the irrigation needs within Kerr County.

- (J-40) Irrigation scheduling – Colorado Basin.
- (J-41) Irrigation scheduling – San Antonio Basin.

J-40 Irrigation Scheduling (Colorado Basin)

This strategy is intended for producers with an adequate supply of water throughout the growing season. It involves scheduling the time and amount of water that is applied to a crop based on the amount of water present in the crop root zone, the amount of water consumed by the crop since the last irrigation, and other considerations. Water savings are difficult to quantify and vary from year to year based on cropping practices, water quality, and quantity. It is estimated that 0.3 to 0.5 acre-feet of water per acre may be saved, according to Best Management Practices for Agricultural Water Users, found on the TWDB's website.

Quantity, Reliability and Cost - According to the 2022 U.S. Ag Census, Kerr County had 67 farms with irrigated land in 2022 and 12,941 acres of irrigated land, which gives an average of 12,688 acres per farm. Assuming that scheduling would conserve 0.3 acre-feet per acre this results in a conservation savings of approximately 3,882 acre-feet per farm for the entire County. This supply volume was divided in half (1,941 acre-feet per year) and is shared with the same strategy for the San Antionio Basin. The reliability of this supply is low due to uncertainty associated with estimated implementation of BMPs. There is no cost associated with implementing this strategy.

J-41 Irrigation Scheduling (San Antonio Basin)

This strategy is intended for producers with an adequate supply of water throughout the growing season. It involves scheduling the time and amount of water that is applied to a crop based on the amount of water present in the crop root zone, the amount of water consumed by the crop since the last irrigation, and other considerations. Water savings are difficult to quantify and vary from year to year based on cropping practices, water quality, and quantity. It is estimated that 0.3 to 0.5 acre-feet of water per acre may be saved, according to Best Management Practices for Agricultural Water Users, found on the TWDB's website.

Quantity, Reliability and Cost - According to the 2022 U.S. Ag Census, Kerr County had 67 farms with irrigated land in 2022 and 12,941 acres of irrigated land, which gives an average of 12,688 acres per farm. Assuming that scheduling would conserve 0.3 acre-feet per acre this results in a conservation savings of approximately 3,882 acre-feet per farm for the entire County. This supply volume was divided in half (1,941 acre-feet per year) and is shared with the same strategy for the Colorado Basin. The reliability of this supply is low due to uncertainty associated with estimated implementation of BMPs. There is no cost associated with implementing this strategy.

5A 3.5 WATER MANAGEMENT STRATEGIES FOR KERR COUNTY LIVESTOCK

Kerr County is projected to have approximately 54 acre-feet of livestock water supply shortage over the planning horizon. Livestock within the County obtains supplies from both surface and groundwater sources. Surface water such as local supply is commonly used but limited due to the recent drought. Groundwater from the Edwards-Trinity (Plateau) Aquifer and the Trinity Aquifer are more reliable sources.

The following water management strategies are recommended to enhance the reliability of the future water supply availability for the livestock needs within Kerr County.

- (J-42) Livestock conservation – Colorado Basin.
- (J-43) Additional groundwater wells - Colorado Basin (ALTERNATE).
- (J-44) Livestock conservation - San Antonio Basin.
- (J-45) Additional groundwater well - San Antonio Basin (ALTERNATE).

J-42 Livestock Conservation (Colorado Basin)

Rotational grazing consists of subdividing grazing pastures and rotating livestock from one pasture to another on a regular interval. This allows the watershed, soils, and vegetation to recover from the stress of continuous livestock grazing. A study by Texas A&M AgriLife Research at Vernon (Ledbetter, 2017) found that changing to a multi-pasture rotational livestock management system reduced surface runoff and sediment load in the local stream by 39 and 34 percent, respectively. The study also found that subsurface flow increased by 48 percent, primarily due to increased infiltration and soil water storage associated with rotational grazing. This strategy assumes a conservative 20 percent reduction of the projected supply need. Six acre-feet per year is assumed for the Colorado Basin livestock conservation strategy. No capital cost is assigned to this strategy.

J-43 Additional Groundwater Well (Colorado Basin) ALTERNATE

The Trinity Aquifer has been identified as a potential source of water to meet the livestock shortages within Kerr County. The Aquifer is comprised of five different water-bearing units which are often in hydraulic communication and collectively should be considered a leaky-aquifer system. Water from this source is generally of acceptable quality for livestock use. Recharge to the Lower Trinity in Kerr County likely occurs primarily by lateral underflow from the north and west. This strategy assumes that three new wells will be drilled to approximately 360 feet below the surface. The wells must be permitted by the Headwaters Groundwater Conservation District and withdrawals must not exceed the Trinity Aquifer MAG limit.

Quantity, Reliability, and Cost – Three new wells at 5-gpm each are assumed to supply an additional 24 acre-feet per year. The reliability of this supply is moderate, based on competing demands. The total cost of this project will be approximately $318,000.

J-44 Livestock Conservation (San Antonio Basin)

Rotational grazing consists of subdividing grazing pastures and rotating livestock from one pasture to another on a regular interval. This allows the watershed, soils, and vegetation to recover from the stress of continuous livestock grazing. A study by Texas A&M AgriLife Research at Vernon (Ledbetter, 2017) found that changing to a multi-pasture rotational livestock management system reduced surface runoff and sediment load in the local stream by 39 and 34 percent, respectively. The study also found that subsurface flow increased by 48 percent, primarily due to increased infiltration and soil water storage associated with rotational grazing. This strategy assumes a conservative 20 percent reduction of the projected supply need. Nine acre-feet per year is assumed for the San Antonio Basin livestock conservation strategy. No capital cost is assigned to this strategy.

J-45 Additional Groundwater Well (San Antonio Basin) ALTERNATE

The Trinity Aquifer has been identified as a potential source of water to meet the livestock shortages within Kerr County. The Aquifer is comprised of five different water-bearing units which are often in hydraulic communication and collectively should be considered a leaky-aquifer system. Water from this source is generally of acceptable quality for livestock use. Recharge to the Lower Trinity in Kerr County likely occurs primarily by lateral underflow from the north and west. This strategy assumes that two new wells will be drilled to approximately 395 feet below the surface. The wells must be permitted by the Headwaters Groundwater Conservation District and withdrawals must not exceed the Trinity Aquifer MAG limit.

Quantity, Reliability, and Cost – The two new 17-gpm wells are assumed to supply an additional 54 acre-feet per year. The reliability of this supply is medium to high, based on competing demands. Total cost of this project will be approximately $255,000.

5A 3.6 WATER MANAGEMENT STRATEGIES FOR KERR COUNTY MINING

Kerr County is projected to have approximately 75 acre-feet of mining water-supply shortage over the planning horizon. Water rights diverted from the Guadalupe River in conjunction with groundwater from the Edwards-Trinity (Plateau) and Trinity Aquifers provide the water needed for mining use within the County. The following water management strategies are recommended to enhance the reliability of the future water supply availability for the mining water-supply shortages within Kerr County.

- (J-46) Mining conservation (Guadalupe Basin).
- (J-47) Additional groundwater wells (Guadalupe Basin).

J-46 Mining Conservation (Guadalupe Basin)

Mining groundwater use in the Plateau Water Planning Area is primarily associated with oil and gas production. Water is needed for well drilling activities, formation fracing, and sand (proppant) mining plants. The PWPG encourages the use of alternative water sources when and where it is economically feasible to do so. For conservation of freshwater resources associated with fracing, on-site treatment of produced and/or flowback water allows for reuse of the water stream. There are numerous third-party vendors who offer mobile produced water recycling systems.

Aggregate Production Operations also use groundwater and surface water to clean and process sand and gravel products. The PWPG encourages the use of water conservation practices as outlined in the Kerr County Voluntary Guidance Document for Aggregate Production Operations.

In 2018, approximately 10 percent of fracwater supply in the Permian Basin was recycled produced water. Conservation of 15 percent of Kerr County mining needs (Guadalupe Basin) would reduce mining needs by 30 acre-feet in all decades throughout the planning period. No capital cost is assigned to this project.

J-47 Additional Groundwater Wells (Guadalupe Basin) ALTERNATE

The Edwards-Trinity (Plateau) Aquifer has been identified as a potential source of water to meet the mining water supply shortages within the County. The Aquifer consists of lower Cretaceous age, saturated limestones and dolomites of the Edwards and Trinity Groups that occur in the Edwards Plateau. Water from this source can be variable, with water quality ranging from fresh to slightly saline in the outcrop areas, and brine water in subsurface portions. Reported well yields commonly range from less than 50 gpm where saturated thickness is thin; to more than 1,000 gpm where large capacity wells are completed in jointed and cavernous limestone. This strategy assumes that three new wells will be drilled to produce water from approximately 360 feet below the surface and produce at a rate of 10-gpm.

Quantity, Reliability, and Cost – Historical industrial and agricultural use indicates that the Edwards-Trinity (Plateau) outcrops may be a viable source. The three new 10-gpm wells are assumed to supply an additional 48 acre-feet per year. The reliability of this supply is medium to high, based on competing demands and water quality issues. Total cost of this project is approximately $360,000.

5A-4 WATER MANAGEMENT STRATEGIES FOR KINNEY COUNTY

5A 4.1 Water Management Strategies for the City of Brackettville

The City of Brackettville is the county seat of Kinney County, with a population projected at 1,077 in 2030; decreasing to 914 by 2080. The City and many other residents of Kinney County rely primarily on groundwater from three different aquifers: Edwards-Trinity (Plateau), Edwards Balcones Fault Zone (BFZ), and the Austin Chalk. Combined, these sources support water use for municipal, domestic, livestock and irrigation purposes. Although the water demand for the City of Brackettville is not projected to increase over the planning horizon, the following water management strategies are recommended to enhance the reliability of the City's future water supply availability.

- (J-48) Increase supply to Spofford with new water line infrastructure.
- (J-49) Increase storage facility.

J-48 Increase Supply to Spofford with New Water Line Infrastructure

The Kinney County Commissioners Court has plans to provide water through a 10.5-mile pipeline from the City of Brackettville to the Kinney County Union Pacific Facility, of which a portion of the line is already in place. This strategy includes an additional 250,000-gallon storage tank located at the end of the pipeline. The storage tank will provide an additional water supply for municipal and industrial purposes.

Quantity, Reliability, and Cost – This strategy will supply approximately three acre-feet of additional water available through transmission to the Kinney County Union Pacific Facility. The reliability of this strategy is high. The total capital cost of this strategy includes the construction of 10.5 miles of six-inch diameter transmission line and a 250,000-gallon storage tank. The total capital cost for this project is estimated at $13,196,000.

J-49 Increase Storage Facility

The City of Brackettville has plans to construct a 125,000-gallon ground storage facility. This storage facility will ensure that adequate water is available to be piped to the Kinney County Union Pacific Facility in Spofford for municipal and industrial purposes (see Strategy J-48 above).

Quantity, Reliability, and Cost – It is assumed that this strategy will provide an additional three acre-feet per year of water. The total estimated capital cost for this project is approximately $1,438,000.

5A 4.2 Water Management Strategies for Fort Clark Springs Mud

Fort Clark Springs MUD is located next to the City of Brackettville and shares the Edwards-Trinity (Plateau) Aquifer for their municipal water supply needs. Although the Fort Clark Springs MUD water demand is not projected to increase over the planning horizon, the following water management strategies are recommended to enhance the reliability of the Community's future water supply availability.

- (J-50) Increase storage facility.

Although the project does not meet SWIFT qualification requirements, Fort Clark Springs MUD is in need of repair or upgrade of pumps in existing wells and the distribution network.

J-50 Increase Storage Facility

The Fort Clark Springs MUD (District) currently has 989 connections, an average daily usage of 0.5 mgd with 660,000 gallons of total storage and a well production capacity of 2 mgd. Additional supply is needed to ensure availability during drought-of-record conditions and to meet peek demands. While the District has the minimum amount of storage available, additional storage will provide the needed water supply. To achieve this goal, a 500,000-gallon ground storage tank will provide access to the new supply.

Quantity, Reliability, and Cost – This strategy is assumed to provide an additional 620 acre-feet per year of water. The total estimated capital cost for this project is approximately $2,499,000.

5A 4.3 Water Management Strategies for Kinney County-Other

Kinney County-Other has a projected population of 502 individuals in 2030, decreasing to 426 individuals by 2080. This compilation of users known as County-Other is self-supplied and relies predominately on groundwater from the Edwards-Trinity (Plateau) Aquifer, Edwards (BFZ) and Austin Chalk Aquifer for their water supply needs. Although Kinney County is not projected to experience a water supply shortage within the planning period, planning for a reliable water supply is important to the communities. The following water management strategies are recommended to help enhance the future water supply availability.

- (J-51) Vegetative management (Nueces Basin).
- (J-52) Vegetative management (Rio Grande Basin).

J-51 Vegetative Management (Nueces Basin)

Several invasive species have been recognized in the Plateau Region, as well as elsewhere in the State, that have a negative impact on surface water flow in springs, creeks, and rivers, as well as recharge to underlying aquifers. Species of major concern are Giant River Cane (Arundo donax) and Elephant Ears (Colocasia esculenta) in watersheds, and the encroachment of woody species such as Ashe-juniper and Mesquite. The PWPG has selected vegetative management as an appropriate water management strategy for several river basins within the Plateau Region. A more detailed description of this strategy is contained in Section 5.2.8 of this Chapter.

Reduced rainfall during drought-of-record conditions certainly reduces aquifer recharge potential. However, some rainfall (and thus recharge) still does occur. Research studies (see Chapter 5, Section 5.2.8) have documented potential recharge impacts resulting from vegetative management. Chapter 7, Section 7.1.1 defines drought-of-record conditions pertaining to rainfall in the Plateau Region as being an average of 20 percent (five inch) reduction in rainfall per year during the 1950's drought and an average 40 percent (10 inch) reduction during more current years. Assuming the worst-case scenario of 40 percent reduction in precipitation will likewise result in 40 percent reduction in average recharge potential, the amount of supply produced for this strategy is 87 acre-feet per year.

J-52 Vegetative Management (Rio Grande Basin)

Several invasive species have been recognized in the Plateau Region, as well as elsewhere in the State, that have a negative impact on surface water flow in springs, creeks, and rivers, as well as recharge to underlying aquifers. Species of major concern are Giant River Cane (Arundo donax) and Elephant Ears (Colocasia esculenta) in watersheds, and the encroachment of woody species such as Ashe-juniper and Mesquite. The PWPG has selected vegetative management as an appropriate water management strategy for several river basins within the Plateau Region. A more detailed description of this strategy is contained in Section 5.2.8 of this Chapter.

Reduced rainfall during drought-of-record conditions certainly reduces aquifer recharge potential. However, some rainfall (and thus recharge) still does occur. Research studies (see Chapter 5, Section 5.2.8) have documented potential recharge impacts resulting from vegetative management. Chapter 7, Section 7.1.1 defines drought-of-record conditions pertaining to rainfall in the Plateau Region as being an average of 20 percent (five inch) reduction in rainfall per year during the 1950's drought and an average 40 percent (10 inch) reduction during more current years. Assuming the worst-case scenario of 40 percent reduction in precipitation will likewise result in 40 percent reduction in average recharge potential, the amount of supply produced for this strategy is 87 acre-feet per year.

5A-5 WATER MANAGEMENT STRATEGIES FOR REAL COUNTY

5A 5.1 Water Management Strategies for the City of Camp Wood

The City of Camp Wood derives most of its municipal water from Old Faithful Spring (also known as Krueger Spring or Camp Wood Spring) that issues from alluvial gravel overlying the Glen Rose Limestone of the Edwards-Trinity (Plateau) Aquifer. However, due to severe drought conditions, Old Faithful Spring is no longer a reliable source of water supply. The discharge from the Spring has been insufficient in meeting all the current needs. To help supplement Old Faithful Spring, the City is operating an additional small well, as backup, which is producing approximately 105 acre-feet per year. The City recognizes the need in developing a reliable, alternate source of supply. The City has been actively seeking funding assistance through various programs for disadvantage communities, to help support the development of two additional groundwater wells in the Edwards-Trinity (Plateau) Aquifer.

Due to the recent drought, the City of Camp Wood in August of 2024 appeared on the TCEQ's Public Water Supply Limiting Water Use list, seeking assistance for emergency funds earmarked for emergency groundwater supply wells. At this time, the City of Camp Wood reported having less than 90-days of reliable water supply.

The City of Camp Wood is projected to have a shortage in 2030 of 147 acre-feet per year; decreasing to 64 acre-feet per year by 2080. The following water management strategies are recommended to enhance the reliability of the City's future water supply availability.

- (J-53) Public conservation education.
- (J-54) Additional wells in the Edwards-Trinity (Plateau) Aquifer.

J-53 Public Conservation Education

The City of Camp Wood is encouraged to emphasize conservation through public information programs. A total of one percent reduction in demand is anticipated, which will result in a water savings of approximately one acre-foot per year. The annual cost of this project in 2030 is estimated to be $920. The total capital cost of this strategy is estimated to be $4,697.

J-54 Additional Wells in the Edwards-Trinity (Plateau) Aquifer

As Old Faithful Spring can no longer be relied upon to provide a sufficient supply of public drinking water, the City of Camp Wood will need to develop a new water supply source from wells completed into the Edwards-Trinity (Plateau) Aquifer. The potential of constructing wells capable of producing at this desired rate is good, although exploratory drilling and testing will likely be needed before this strategy can be relied upon as a dependable source. Due to high levels of iron and manganese, advanced treatment will likely be required for municipal use. This strategy includes the construction of four new wells to be completed at 1,000 feet below the surface, each operating at a capacity of 40-gpm. The location of the additional wells is assumed to be near the City's current treatment plant. This project will require approximately 500 feet of six-inch diameter connection piping.

Quantity, Reliability, and Cost – Four new wells are assumed to supply an additional 258 acre-feet per year. The reliability of this supply is medium to high, based on competing demands. Total estimated capital cost for this project is $2,531,000.

5A 5.2 WATER MANAGEMENT STRATEGIES FOR THE CITY OF LEAKEY

The City of Leakey relies primarily on the Edwards-Trinity (Plateau) Aquifer and the Frio River Alluvium Aquifer for municipal water supply purpose. Small volumes of surface water are used to supplement the irrigation water supply needs of the City. Although the supply-demand analysis does not project a future water-supply deficit for the City of Leakey, drought like conditions continues to impact the City's water supplies. The following water management strategies are recommended to enhance the reliability of the City's future water supply availability.

- (J-55) Public conservation education.
- (J-56) Drill additional well in the Lower Trinity Aquifer.
- (J-57) Develop interconnection between wells within the City of Leakey.

J-55 Public Conservation Education

The City of Leakey is encouraged to emphasize conservation through public information programs. A total of one percent reduction in demand is anticipated, which will result in a water savings of approximately one acre-foot per year. The annual cost of this project in 2030 is estimated to be $1,172. The total capital cost for this strategy is estimated to be $5,979.

J-56 Drill Additional Well in the Lower Trinity Aquifer

The City of Leakey currently has a total of six Frio River Alluvium Aquifer wells, with the sixth well recently being completed in 2014. The City has plans to connect all the wells within their system in order for the public water supply system to become a more reliable future source of supply. During the recent drought, it appeared that the water level would drop to the point where one or more of these wells would no longer be viable. In consideration of this limited groundwater availability, the Real Edwards Conservation and Reclamation District passed an emergency rule that allowed for the immediate permitting of an additional well or other potential water source for the City of Leakey. In addition, the City is looking at a solid waste disposal system and it is anticipated that such a system will require additional water.

Sufficient groundwater is available from the Frio River Alluvium Aquifer without causing excessive water-level declines; however, in severe drought alluvial aquifers are the first to go dry. For this reason, it is recommended that the new well be completed in the Lower Trinity Aquifer.

This strategy assumes that the construction of one new well will be drilled to a depth of 750 feet to access the additional Aquifer supplies needed. The well is assumed to be operating at a capacity of 75-gpm. In addition, this strategy includes 500 feet of six-inch diameter connection piping. Minimal treatment, such as chlorine disinfection, will be required for municipal purposes.

Quantity, Reliability, and Cost –The Lower Trinity Aquifer is identified as a potential and viable source to meet water-supply needs for the City of Leakey: however, water quality issues may require advanced treatment. For this *Plan*, the one new 75-gpm well is assumed to supply an additional 91 acre-feet per year. The reliability of the supply is medium based on water quantity issues. Total estimated capital cost for this project is approximately $646,000.

J-57 Develop Interconnections between Wells within the City of Leakey

The City of Leakey has developed their current water supply system based on individual wells providing water to sections of the City. The current drought had a significant impact on the City's alluvial wells with some of the wells dropping to levels where they could not be pumped. This experience has demonstrated the need to integrate the system as both a conservation and water supply strategy. By interconnecting the independent systems, an additional 81 acre-feet per year of water can be pumped to other areas, thus reducing the demands on each individual well. This would potentially prevent the over drafting of wells during drought periods. The key well that would be incorporated into the system is Well #5. This strategy assumes approximately 3,500 feet of 6-inch line will need to be installed to connect all wells and the installation of a SCADA system is recommended.

Quantity, Reliability, and Cost – This strategy is assumed to supply an additional 81 acre-feet per year of water. The total estimated capital cost for this project is approximately $791,000.

5A 5.3 WATER MANAGEMENT STRATEGIES FOR REAL COUNTY-OTHER

The rural area of Real County-Other has less than 1,940 in population including individuals living outside of Leakey and Camp Wood. This compilation of water users known as "County-Other" is self-supplied and relies primarily on groundwater from the Nueces River Alluvium and Edwards-Trinity (Plateau) Aquifers for their water-supply needs as produced from private domestic wells or by small public systems such as the Real Water Supply Corporation. A modest source of supply is also provided by the Edwards-Trinity (Plateau) Aquifer.

Much of the rural economy is based on ranching operations, which relies on local surface streams to provide water for their livestock. Natural flow in these streams is negatively influenced by the presence of non-native plant species.

Although the supply-demand analysis does not project a future water-supply deficit for Real County-Other, rural communities within the area have certainly suffered from extreme drought conditions. The following water management strategies are recommended to enhance the reliability of the future water supply for residents within rural Real County.

- (J-58) Water loss audit and main-line repair for Real Water Supply Corporation.
- (J-59) Additional groundwater well for Oakmont Saddle Mountain Water Supply Corporation.
- (J-60) Vegetative management (Nueces Basin).

J-58 Water Loss Audit and Main-line Repair for Real Water Supply Corporation

According to the 2022 TWDB Public Water System Water Loss Survey, Real WSC had a total water loss (as opposed to apparent "paper" losses) of six acre-feet in 2022 (22 percent) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water-supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This strategy will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability and Cost - The strategy assumes one mile of six-inch diameter pipe will be replaced, at a total estimated project capital cost of $1,065,000. The strategy is estimated to generate a potential savings of one acre-foot of water per year throughout the planning period.

J-59 Additional Well for Oakmont Saddle Mountain Water Supply Corporation

Due to the recent drought, Oakmont Saddle Mountain WSC has experienced the loss of production in supply well #1. Currently, the WSC is operating on water well #2, an unapproved temporary shallow well in the Frio River Alluvium Aquifer. Real County received a Disaster Relief Grant from the Texas Department of Agriculture on June 13, 2012, to benefit Oakmont Saddle Mountain WSC for a system improvement project that will replace well #1. Through a series of failed attempts to successfully reach a reliable water supply, the water supply corporation had to abandon efforts on the construction of two wells. Since then, the WSC has drilled an experimental fourth well five feet from one of the previous wells, which involved an excavation three feet in width, 40 feet in depth and 11 feet to bedrock. This was performed for the purpose of considering a filtration zone constructed through the removal of alluvial gravel and installation of an 8” PVC perforated pipe.

To bring this new supply on-line will require the construction of the well facility and its connection to the distribution system. This strategy assumes a spring water source with the construction of a watertight concrete basin, installation of pump and associated piping, electrical and all appurtenances. Authorization to construct this spring water source well was issued by TCEQ letter dated October 24, 2014.

Quantity, Reliability, and Cost – It is anticipated that this strategy will provide an additional 54 acre-feet per year of water. The total estimated project cost is $615,000. The reliability of this source is low to medium depending on the surface water availability. Shallow alluvium wells are typically the first water supply to become an unreliable source during drought like conditions.

J-60 Vegetative Management (Nueces Basin)

Several invasive species have been recognized in the Plateau Region, as well as elsewhere in the State, that have a negative impact on surface water flow in springs, creeks, and rivers, as well as recharge to underlying aquifers. Species of major concern are Giant River Cane (Arundo donax) and Elephant Ears (Colocasia esculenta) in watersheds, and the encroachment of woody species such as Ashe-juniper and Mesquite. The PWPG has selected vegetative management as an appropriate water management strategy for several river basins within the Plateau Region. A more detailed description of this strategy is contained in Section 5.2.8 of this Chapter.

Reduced rainfall during drought-of-record conditions certainly reduces aquifer recharge potential. However, some rainfall (and thus recharge) still does occur. Research studies (see Chapter 5, Section 5.2.8) have documented potential recharge impacts resulting from vegetative management. Chapter 7, Section 7.1.1 defines drought-of-record conditions pertaining to rainfall in the Plateau Region as being an average of 20 percent (five inch) reduction in rainfall per year during the 1950’s drought and an average 40 percent (10 inch) reduction during more current years. Assuming the worst-case scenario of 40 percent reduction in precipitation will likewise result in 40 percent reduction in average recharge potential, the amount of supply produced for this strategy is 87 acre-feet per year.

5A 5.4 WATER MANAGEMENT STRATEGIES FOR REAL COUNTY MANUFACTURING

Much of the water needs for manufacturing operations within Real County are self-supplied from private/company water wells. Projected manufacturing water-supply shortages in Real County begin in 2030 with a two acre-feet per year deficit held constant throughout the planning horizon. The following water management strategy is recommended to enhance the Manufacturing industry's future water-supply availability.

- (J-61) Manufacturing conservation

J-61 Manufacturing Conservation

The PWPG encourages the use of alternative water sources when and where it is economically feasible to do so. For conservation of freshwater resources manufacturing entities can follow several of these recommendations: (1) conduct a water audit, (2) install water-saving equipment, (3) reuse water, (4) harvest rainwater, (5) adopt water management technologies, and (6) set targets and incentives.

Conservation of 50 percent of Real County manufacturing needs in 2030 would reduce manufacturing needs by one acre-foot held constant throughout the planning period. This strategy does not provide enough water supply to absorb the projected water-supply deficit of two acre-feet per year. Most often, manufacturing companies will consider how best to implement the above recommendations for best management practices and resolve any expected water supply deficits. This strategy is not associated with any costs.

5A-6 WATER MANAGEMENT STRATEGIES FOR VAL VERDE COUNTY

5A 6.1 Water Management Strategies for the City of Del Rio

The City of Del Rio is the only wholesale water provider / major water provider in the Plateau Region. In addition to its own use, the City provides water to Laughlin Air Force Base and subdivisions outside of the City. Del Rio also provides water and wastewater services to two colonias: Cienegas Terrace and Val Verde Park Estates.

The City of Del Rio relies primarily on San Felipe Springs, which issues from the Edwards-Trinity (Plateau) Aquifer but has also been designated as being under the influence of surface water by TCEQ. The water is collected through pumps set in the springs, treated with microfiltration and chlorine and then connected to the distribution system. The City of Del Rio has a water right authorizing it to divert 11,416 acre-feet per year from San Felipe Springs for municipal use. Elsewhere in the County, all known water wells produce water from the Salmon Peak and McKnight Formations of the Edwards Group.

The average discharge of San Felipe Springs since Lake Amistad was filled is about 110 cubic feet per second (cfs), approximately 80,000 acre-feet per year. During recent droughts, the spring discharge has fallen below 50 cfs, approximately 36,000 acre-feet per year. The diminished supply availability from the Springs during drought periods requires Del Rio to consider other water supply options.

Recently, the City of Del Rio has been exploring an alternative source of water supply. Del Rio has completed one pilot well within the Edwards-Trinity (Plateau) Aquifer, drilled to a depth of approximately 200-250 feet. The pilot well was a success, producing roughly 3,223 acre-feet per year. The City recognizes the importance of transitioning away from the drought impacted spring flows, to a more reliable water-supply source that can sustain future growth. Therefore, the City has plans to drill a second well.

The following water management strategies are recommended to enhance the reliability of the City's future water supply availability.

- (J-62) Water loss audit and main-line repair for the City of Del Rio.
- (J-63) Additional groundwater well.
- (J-64) Water treatment plant expansion.
- (J-65) Develop a wastewater reuse program.

In addition to the recommended strategies listed above, the City of Del Rio has the following funded, water projects listed with the TWDB as of November 2014:

- Installation of reverse osmosis at water treatment plant.
- Water main replacement.
- Collection system reconstruction.

J-62 Water Loss Audit and Main-line Repair for the City of Del Rio

According to the 2022 TWDB Public Water System Water Loss Survey, the City of Del Rio had a total water loss (as opposed to apparent "paper" losses) of 2,366 acre-feet in 2022 (27 percent) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water-supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This strategy will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability and Cost - The strategy assumes 84 miles of six-inch diameter pipe will be replaced, at a total estimated project capital cost of $89,466,000. The strategy is estimated to generate a potential savings of 631 acre-feet of water per year throughout the planning period.

J-63 Additional Groundwater Well

The City of Del Rio currently has a total of three wells located north of town; however, due to complications with the production of these wells, all three wells are presently inactive. In order to alleviate the water demand from San Felipe Springs, Del Rio plans to locate an alternate source of supply. The Edwards-Trinity (Plateau) Aquifer has been identified as groundwater source for future water supplies. This source may require minimal treatment such as chlorine disinfection for municipal purposes. As the three existing inactive wells are not classified as being active water supply sources, the addition of a new well is considered a new supply source.

Quantity, Reliability, and Cost – This strategy assumes the development of one new well located near the existing wells, north of town. The well will be drilled at a depth of 650 feet and is anticipated to produce an additional 7,191 acre-feet per year. This strategy includes 0.5 miles of 24-inch diameter transmission line. The total capital cost is estimated to be approximately $19,764,000.

J-64 Water Treatment Plant Expansion

The City of Del Rio uses a membrane treatment facility, which treats water pumped from San Felipe Springs. The treatment plant is approximately 15-years old and needs two additional pods to keep pace with the communities growing water demands. This strategy assumes costs associated with the 1 mgd treatment plant expansion which is anticipated to come on-line by 2040.

Quantity, Reliability, and Cost – It is expected that this project will supply an additional 943 acre-feet per year. The total capital cost for this project is approximately $10,489,000 with an estimated annual cost of $1,490,000.

J-65 Develop a Wastewater Reuse Program

A long-term strategy for the City is to expand its wastewater effluent for irrigation of the municipal golf course, provide reuse water to Laughlin AFB, and eventually to irrigate public parks. Additional treated wastewater will be generated from improvements at the San Felipe and Silver Lake Wastewater Treatment Plants. The primary component of this strategy is the approximate 10-mile extension of the major transmission lines that convey the direct reuse supplies to the intended destinations.

Quantity, Reliability, and Cost – The current wastewater discharge permit for the City of Del Rio is 2.7 mgd (3,092 acre-feet per year). The effluent provided for reuse will be a continual supply available daily for municipal uses. It is expected that this project will supply an additional 3,092 acre-feet per year. The total capital cost for this project is approximately $11,451,000.

5A 6.2 WATER MANAGEMENT STRATEGIES FOR VAL VERDE COUNTY-OTHER

The rural area of Val Verde County has a population projected at 17,639 in 2030, increasing to 18,402 by 2080. This population includes individuals living outside of the City of Del Rio and Laughlin AFB. This compilation of water users known as "County Other" is partially supplied by Del Rio but is mostly self-supplied and relies solely on the Edwards-Trinity (Plateau) Aquifer for their water supply needs either from private domestic wells, or privately owned water supply systems. Much of the rural economy is based on ranching operations, which relies on local surface streams to provide water for their livestock. Natural flow in these streams is negatively influenced by the presence of non-native plant species.

Although the supply-demand analysis does not project a future water-supply deficit for Val Verde County-Other, the following water management strategies are recommended to enhance the reliability of the future water supply for residents within Val Verde County Other.

- (J-66) Water loss audit and main-line repair for San Pedro Canyon Subdivision (Upper).
- (J-67) Water loss audit and main-line repair for Tierra del Lago.
- (J-68) Vegetative management.

J-66 Water Loss Audit and Main-line Repair for San Pedro Canyon Subdivision (Upper)

According to the 2021 TWDB Public Water System Water Loss Survey, San Pedro Canyon Subdivision (Upper) system had a total water loss (as opposed to apparent "paper" losses) of 11 acre-feet in 2021 (26 percent) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water-supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This strategy will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability and Cost - The strategy assumes one mile of six-inch diameter pipe will be replaced, at a total estimated project capital cost of $1,065,000. The strategy is estimated to generate a potential savings of three acre-feet of water per year throughout the planning period.

J-67 Water Loss Audit and Main-line Repair for Tierra Del Lago

According to the 2022 TWDB Public Water System Water Loss Survey, Tierra Del Lago system had a total water loss (as opposed to apparent "paper" losses) of nine acre-feet in 2022 (57 percent) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water-supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This strategy will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability and Cost - The strategy assumes one mile of six-inch diameter pipe will be replaced, at a total estimated project capital cost of $1,065,000. The strategy is estimated to generate a potential savings of five acre-feet of water per year throughout the planning period.

J-68 Vegetative Management

Several invasive species have been recognized in the Plateau Region, as well as elsewhere in the State, that have a negative impact on surface water flow in springs, creeks, and rivers, as well as recharge to underlying aquifers. Species of major concern are Giant River Cane (Arundo donax) and Elephant Ears (Colocasia esculenta) in watersheds, and the encroachment of woody species such as Ashe-juniper and Mesquite. The PWPG has selected vegetative management as an appropriate water management strategy for several river basins within the Plateau Region. A more detailed description of this strategy is contained in Section 5.2.8 of this Chapter.

Reduced rainfall during drought-of-record conditions certainly reduces aquifer recharge potential. However, some rainfall (and thus recharge) still does occur. Research studies (see Chapter 5, Section 5.2.8) have documented potential recharge impacts resulting from vegetative management. Chapter 7, Section 7.1.1 defines drought-of-record conditions pertaining to rainfall in the Plateau Region as being an average of 20 percent (five inch) reduction in rainfall per year during the 1950's drought and an average 40 percent (10 inch) reduction during more current years. Assuming the worst-case scenario of 40 percent reduction in precipitation will likewise result in 40 percent reduction in average recharge potential, the amount of supply produced for this strategy is 87 acre-feet per year.

5A 6.3 WATER MANAGEMENT STRATEGIES FOR VAL VERDE COUNTY MINING

The mining industry in Val Verde County is projected to have a water supply deficit beginning in 2040 of six acre-feet per year, increasing to 38 acre-feet per year by 2080. Both surface water and groundwater supplies provide water for mining purposes within the County. The Edwards-Trinity (Plateau) Aquifer is the sole groundwater source used for mining purposes. The following water management strategies are recommended to enhance the reliability of the future water-supply availability for the mining water supply shortages within Val Verde County.

- (J-69) Mining conservation.
- (J-70) Additional groundwater wells.

J-69 Mining Conservation

Mining groundwater use in the Plateau Water Planning Area is primarily associated with oil and gas production. Water is needed for well drilling activities, formation fracing, and sand (proppant) mining plants. The PWPG encourages the use of alternative water sources when and where it is economically feasible to do so. For conservation of freshwater resources associated with fracing, on-site treatment of produced and/or flowback water allows for reuse of the water stream. There are numerous third-party vendors who offer mobile produced water recycling systems.

In 2018, approximately 10 percent of fracwater supply in the Permian Basin was recycled produced water. Conservation of 15 percent of Val Verde County mining needs (Rio Grande Basin) would reduce mining needs by 15 acre-feet in all decades throughout the planning period. No capital cost is assigned to this project.

J-70 Additional Groundwater Wells

The Edwards-Trinity (Plateau) Aquifer has been identified as a potential source of water to meet the mining water supply shortage within Val Verde County. The Aquifer consists of lower Cretaceous age, saturated limestones and dolomites of the Edwards and Trinity Groups that occur in the Edwards Plateau. Water from this source can be variable, with water quality ranging from fresh to slightly saline in the outcrop areas, and brine water in subsurface portions. Reported well yields commonly range from less than 50-gpm where saturated thickness is thin; to more than 1,000-gpm where large capacity wells are completed in jointed and cavernous limestone. This strategy assumes that three new wells will be drilled to produce 50-gpm of water from approximately 900 feet below the surface.

Quantity, Reliability, and Cost – The three new wells are assumed to supply an additional 242 acre-feet per year. The reliability of this supply is medium to high, based on competing demands and water quality issues. Total cost of this project will be approximately $1,348,000.

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APPENDIX 5B
STRATEGY EVALUATION
QUANTIFICATION MATRIX

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STRATEGY EVALUATION QUANTIFICATION MATRIX

The practicality of an implemented water management strategy may be measured in terms of quantity, quality and reliability of water produced and the varying degree of impact (positive or negative) on pre-existing local conditions. The Plateau Water Planning Group (PWPG) has adopted a standard procedure for ranking potential water management strategies. Quantitative and qualitative measurements are tabulated in Chapter 5 Tables 5-2 and 5-4. This procedure classifies the strategies using the TWDB's following standard categories developed for regional water planning:

Table 5-2

- Quantity
- Quality
- Reliability
- Impact of Water, Agricultural, and Natural Resources

Table 5-4

- Environmental Impact
    - Environmental water needs
    - Wildlife habitat
    - Cultural resources
    - Environmental water quality
    - Bays and estuaries

Quantity, Quality and Reliability

Quantity, quality and reliability are quantitatively assessed and assigned a ranking from 1 to 3 as listed in the Matrix Table below, which shows the correlation between the category and the ranking.

Table 5B-1. Quantity, Quality and Reliability Category Ranking Matrix

Rank	Quantity	Quality	Reliability
1	Meets 100% of shortage	Meets safe drinking water standards	Sustainable
2	Meets 50-99% of shortage	Must be treated or mixed to meet safe drinking water standards	Interruptible
3	Meets < 50% of shortage	Usable for intended non-drinking use only	Un-sustainable

<u>Quantity</u> adequacy is measured as a percent of the volume of water needed to meet the specified water user group's (WUG's) shortage as calculated in Table 4-1 of Chapter 4 that is produced by the water management strategy. Percent volumes are only analyzed for WUGs with projected supply shortages.

<u>Quality</u> adequacy is measured in terms of meeting TCEQ Safe Drinking Water Standards. However, not all strategies are intended for use requiring SDWSs.

<u>Reliability</u> is evaluated based on the expected or potential for the water to be available during drought. Strategies that use water from a source that would not exceed permits or MAGs even during droughts are rated as <u>sustainable</u>. Strategies that use water from a source that is available during normal meteorological conditions but may not be 100 percent available during drought are rated as <u>interruptible</u>. Strategies in which 100 percent of the supply cannot be maintained even during normal meteorological conditions are rated as <u>unsustainable</u>.

<u>Impact on Water, Agricultural and Natural Resources</u>

Impacts are quantitatively assessed and assigned a ranking from 1 to 5 as listed in the Matrix Table below, which shows the correlation between the category and the ranking.

Table 5B-2. Strategy Impact Category Ranking Matrix

Rank	Water Resources	Agricultural Resources	Natural Resources
1	Positive	Positive	Positive
2	None	None	None
3	Low	Low	Low
4	Medium	Medium	Medium
5	High	High	High

<u>Water Resources</u> impacts refer to the potential for the implemented strategy to compete for water sources shared with adjacent properties. The matrix ranking depicts the potential range of water-level drawdown induced across property boundaries during the life of the strategy project.

1 Positive - No aquifer drawdown; increased surface water flow

2 None – No new aquifer drawdown; no change to surface water flow

3 Low – <10 feet of aquifer drawdown; < 10 percent reduction in average surface flows

4 Medium – 10 to 50 feet of aquifer drawdown; 10 to 30 percent reduction in average surface flows

5 High - > 50 feet of aquifer drawdown; > 30 percent reduction in surface flows

Agricultural Resources impacts refer to the agricultural economic impact resulting from the loss or gain of water supplies currently in use by the agricultural user as the result of the implementation of a strategy. See Section 1.2.8 in Chapter 1 for a detailed discussion on the Agricultural Resources of the Plateau Region.

1 Positive – provides water to agricultural users

2 None – does not impact agricultural supplies

3 Low – reduces agricultural activity by less than 10 percent

4 Medium – reduces agricultural activity by more than 10 percent

5 High – water rights use changes from agricultural to some other use thus elimination agricultural activity

Natural Resources impacts are those that impact the terrestrial and aquatic habitat of native plant and animal wildlife, as well as the scenic beauty of the Region that is critical to the tourism industry. See Section 1.2.8 in Chapter 1 for a detailed discussion on the Natural Resources of the Plateau Region.

1 Positive – provides water to natural resources

2 None – does not impact natural resources

3 Low – reduces natural resources water supply by less than 10 percent

4 Medium – reduces natural resources water supply by more than 10 percent

5 High – reduces natural resources water supply by more than 50 percent

Environmental Impacts are quantitatively assessed and assigned a ranking from 1 to 5 as listed in the Matrix Table below, which shows the correlation between the category and the ranking. The Environmental Matrix takes into consideration the following categories:

- Environmental Water Needs
- Wildlife Habitat
- Cultural Resources
- Environmental Water Quality
- Bays and Estuaries

Table 5B-3. Environmental Impact Category Ranking Matrix

Rank	Environmental Water Needs	Wildlife Habitat	Cultural Resources	Environmental Water Quality	Bays and Estuaries
1	Positive	Positive	Positive	Positive	Not applicable
2	No new	No new	No new	No new	
3	Minimal negative	Minimal negative	Minimal negative	Minimal negative	
4	Moderate negative	Moderate negative	Moderate negative	Moderate negative	
5	Significant negative	Significant negative	Significant negative	Significant negative	

Environmental Water Needs impacts refer to how the strategy will impact the area's overall environmental water needs. Water is vital to the environmental health of a region, and so it is important to consider how strategies will impact the amount of water that will be available to the environment.

1 Positive – additional water will be introduced for environmental use

2 No new – no additional water will be introduced for environmental use

3 Minimal negative – environmental water needs will be reduced by <10 percent

4 Moderate negative – environmental water needs will be reduced by 10 to 30 percent

5 Significant negative - environmental water needs will be reduced by >30 percent

Wildlife Habitat impacts refer to how the strategy will impact the wildlife habitat of the local area. The more area that is impacted due to the implementation of the strategy, the more the area's habitat will be disrupted.

1 Positive – additional habitat area for wildlife use will be created

2 No new – no additional habitat area for wildlife use will be created or destroyed

3 Minimal negative – wildlife habit will be reduced by < 100 acres

4 Moderate negative – wildlife habit will be reduced by 100 to 1,000 acres

5 Significant negative - wildlife habit will be reduced by > 1,000 acres

<u>Cultural Resources</u> impacts refer to how the strategy will impact cultural resources located within the area. Cultural resources are defined as the collective evidence of the past activities and accomplishments of people. Locations, buildings and features with scientific, cultural or historic value are considered to be cultural resources.

1 Positive – cultural resources will be identified and protected

2 No new – no impact will occur to local cultural resources

3 Minimal negative – disturbance to cultural resources will be < 10 percent

4 Moderate negative – disturbance to cultural resources will be 10 to 20 percent

5 Significant negative - disturbance to cultural resources will be > 20 percent

<u>Environmental Water Quality</u> impacts refer to the impact that the implementation of the strategy will have on the local area's natural water quality. Negative impacts could include the introduction of poorer quality water, the reduction of the natural flow of water of native quality source water, or the introduction of detrimental chemical elements into the natural water ways.

1 Positive – water quality of area streams will be enhanced for existing environmental use

2 No new – water quality characteristics of existing environmental habitat will not be changed

3 Minimal negative – water quality characteristics of existing environmental habitat will be negatively altered by < 10 percent

4 Moderate negative – water quality characteristics of existing environmental habitat will be negatively altered by < 10 to 30 percent

5 Significant negative - water quality characteristics of existing environmental habitat will be negatively altered by > 30 percent

<u>Bays and Estuaries</u> – The Plateau Region is located too far away from any bays and estuaries of the Texas coastline to have a quantifiable impact. Therefore, this category was assumed to be non-applicable for every strategy.

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APPENDIX 5C
UNIFORM COSTING MODEL
STANDARDIZED COST OUTPUT
REPORTS

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Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
J-1 City of Bandera - Water Loss Audit & Main-Line Repair

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Conservation (Leaking Pipe/Meter Replacement)	$4,031,000
TOTAL COST OF FACILITIES	**$4,031,000**
- Planning (3%)	$121,000
- Design (7%)	$282,000
- Construction Engineering (1%)	$40,000
Legal Assistance (2%)	$81,000
Fiscal Services (2%)	$81,000
Pipeline Contingency (15%)	$605,000
Interest During Construction (3.5% for 0.5 years with a 0.5% ROI)	$86,000
TOTAL COST OF PROJECT	**$5,327,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$375,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$375,000**
Available Project Yield (acft/yr)	5
Annual Cost of Water ($ per acft), based on PF=0	$75,000
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$0
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$230.13
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.00

JKJ *1/22/2025*

Cost Estimate Summary *Water Supply Project Option* *September 2023 Prices* *J-2 City of Bandera - Reuse Treated Wastewater Effluent for Irrigation Use*	
Cost based on ENR CCI 13485.67 for September 2023 and *a PPI of 278.502 for September 2023*	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (0 MGD)	$726,000
Transmission Pipeline (6 in. dia., 0.9 miles)	$763,000
TOTAL COST OF FACILITIES	**$1,489,000**
- Planning (3%)	$45,000
- Design (7%)	$104,000
- Construction Engineering (1%)	$15,000
Legal Assistance (2%)	$30,000
Fiscal Services (2%)	$30,000
Pipeline Contingency (15%)	$115,000
All Other Facilities Contingency (20%)	$145,000
Environmental & Archaeology Studies and Mitigation	$47,000
Land Acquisition and Surveying (7 acres)	$30,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$67,000
TOTAL COST OF PROJECT	**$2,117,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$149,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$8,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$18,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (40596 kW-hr @ 0.09 $/kW-hr)	$4,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$179,000**
Available Project Yield (acft/yr)	310
Annual Cost of Water ($ per acft), based on PF=1.5	$577
Annual Cost of Water After Debt Service ($ per acft), based on PF=1.5	$97

Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$1.77
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$0.30
JKJ	*1/22/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
J-3 City of Bandera - Promote, Design & Install Rainwater Harvesting Systems

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Integration, Relocations, Backup Generator & Other	$59,000
TOTAL COST OF FACILITIES	**$59,000**
- Planning (3%)	$2,000
- Design (7%)	$4,000
- Construction Engineering (1%)	$1,000
Legal Assistance (2%)	$1,000
Fiscal Services (2%)	$1,000
All Other Facilities Contingency (20%)	$12,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$3,000
TOTAL COST OF PROJECT	**$83,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$6,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$1,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$7,000**
Available Project Yield (acft/yr)	1
Annual Cost of Water ($ per acft), based on PF=0	$7,000
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$1,000
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$21.48
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$3.07

Note: One or more cost element has been calculated externally

JKJ *1/22/2025*

Cost Estimate Summary Water Supply Project Option September 2023 Prices J-4 City of Bandera - Additional Lower Trinity Well	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (0 MGD)	$808,000
Transmission Pipeline (8 in. dia., 4 miles)	$3,483,000
Well Fields (Wells, Pumps, and Piping)	$753,000
Water Treatment Plant (0.4 MGD)	$55,000
TOTAL COST OF FACILITIES	**$5,099,000**
- Planning (3%)	$153,000
- Design (7%)	$357,000
- Construction Engineering (1%)	$51,000
Legal Assistance (2%)	$102,000
Fiscal Services (2%)	$102,000
Pipeline Contingency (15%)	$522,000
All Other Facilities Contingency (20%)	$323,000
Environmental & Archaeology Studies and Mitigation	$128,000
Land Acquisition and Surveying (6 acres)	$7,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$223,000
TOTAL COST OF PROJECT	**$7,067,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$497,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$42,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$20,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$33,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (210386 kW-hr @ 0.09 $/kW-hr)	$19,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$611,000**

Available Project Yield (acft/yr)	403
Annual Cost of Water ($ per acft), based on PF=1.5	$1,516
Annual Cost of Water After Debt Service ($ per acft), based on PF=1.5	$283
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$4.65
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$0.87
JKJ	*1/22/2025*

Cost Estimate Summary Water Supply Project Option September 2023 Prices J-5 City of Bandera - Additional Middle Trinity Well	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$773,000
TOTAL COST OF FACILITIES	**$773,000**
- Planning (3%)	$23,000
- Design (7%)	$54,000
- Construction Engineering (1%)	$8,000
Legal Assistance (2%)	$15,000
Fiscal Services (2%)	$15,000
All Other Facilities Contingency (20%)	$155,000
Environmental & Archaeology Studies and Mitigation	$22,000
Land Acquisition and Surveying (1 acres)	$14,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$36,000
TOTAL COST OF PROJECT	**$1,115,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$79,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$8,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (70326 kW-hr @ 0.09 $/kW-hr)	$6,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$93,000**
Available Project Yield (acft/yr)	161
Annual Cost of Water ($ per acft), based on PF=0	$578
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$87
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.77

Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.27
JKJ	*1/22/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
J-6 City of Bandera - Surface Water Acquisition, Treatment & ASR

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,742,000
Water Treatment Plant (0 MGD)	$34,488,000
TOTAL COST OF FACILITIES	**$36,230,000**
- Planning (3%)	$1,087,000
- Design (7%)	$2,536,000
- Construction Engineering (1%)	$362,000
Legal Assistance (2%)	$725,000
Fiscal Services (2%)	$725,000
All Other Facilities Contingency (20%)	$7,246,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$1,590,000
TOTAL COST OF PROJECT	**$50,501,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$3,553,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$17,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$3,570,000**
Available Project Yield (acft/yr)	1,500
Annual Cost of Water ($ per acft), based on PF=0	$2,380
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$11
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$7.30
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.03

Note: One or more cost element has been calculated externally

JKJ *1/22/2025*

Cost Estimate Summary *Water Supply Project Option* *September 2023 Prices* *J-8 Bandera County FWSD #1 - Additional Groundwater Well*	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$467,000
Storage Tanks (Other Than at Booster Pump Stations)	$593,000
Water Treatment Plant (0.3 MGD)	$47,000
TOTAL COST OF FACILITIES	**$1,107,000**
- Planning (3%)	$33,000
- Design (7%)	$77,000
- Construction Engineering (1%)	$11,000
Legal Assistance (2%)	$22,000
Fiscal Services (2%)	$22,000
All Other Facilities Contingency (20%)	$221,000
Environmental & Archaeology Studies and Mitigation	$12,000
Land Acquisition and Surveying (3 acres)	$7,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$50,000
TOTAL COST OF PROJECT	**$1,562,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$110,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$11,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$28,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (43694 kW-hr @ 0.09 $/kW-hr)	$4,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$153,000**
Available Project Yield (acft/yr)	100
Annual Cost of Water ($ per acft), based on PF=0	$1,530

Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$430
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$4.69
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$1.32
JKJ	*1/22/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
J-9 Bandera County-Other (Bridlegate Subdivision) - Water Loss Audit & Main-Line Repair

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Conservation (Leaking Pipe/Meter Replacement)	$1,612,000
TOTAL COST OF FACILITIES	**$1,612,000**
- Planning (3%)	$48,000
- Design (7%)	$113,000
- Construction Engineering (1%)	$16,000
Legal Assistance (2%)	$32,000
Fiscal Services (2%)	$32,000
Pipeline Contingency (15%)	$242,000
Interest During Construction (3.5% for 0.5 years with a 0.5% ROI)	$35,000
TOTAL COST OF PROJECT	**$2,130,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$150,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$150,000**
Available Project Yield (acft/yr)	1
Annual Cost of Water ($ per acft), based on PF=0	$150,000
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$0
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$460.26
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.00

JKJ *1/22/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
J-10 Bandera County-Other (Flying L Ranch PUD) - Water Loss Audit & Main-Line Repair

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Conservation (Leaking Pipe/Meter Replacement)	$806,000
TOTAL COST OF FACILITIES	**$806,000**
- Planning (3%)	$24,000
- Design (7%)	$56,000
- Construction Engineering (1%)	$8,000
Legal Assistance (2%)	$16,000
Fiscal Services (2%)	$16,000
Pipeline Contingency (15%)	$121,000
Interest During Construction (3.5% for 0.5 years with a 0.5% ROI)	$18,000
TOTAL COST OF PROJECT	**$1,065,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$75,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$75,000**
Available Project Yield (acft/yr)	2
Annual Cost of Water ($ per acft), based on PF=0	$37,500
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$0
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$115.07
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.00

JKJ *1/22/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

J-11 Bandera County-Other (Medina WSC) - Additional Groundwater Well

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$873,000
Storage Tanks (Other Than at Booster Pump Stations)	$593,000
Water Treatment Plant (0.3 MGD)	$47,000
TOTAL COST OF FACILITIES	**$1,513,000**
- Planning (3%)	$45,000
- Design (7%)	$106,000
- Construction Engineering (1%)	$15,000
Legal Assistance (2%)	$30,000
Fiscal Services (2%)	$30,000
All Other Facilities Contingency (20%)	$303,000
Environmental & Archaeology Studies and Mitigation	$12,000
Land Acquisition and Surveying (3 acres)	$7,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$68,000
TOTAL COST OF PROJECT	**$2,129,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$150,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$15,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$28,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (110204 kW-hr @ 0.09 $/kW-hr)	$10,000
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$203,000**
Available Project Yield (acft/yr)	55
Annual Cost of Water ($ per acft), based on PF=0	$3,691

Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$964
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$11.33
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$2.96
JKJ	*1/22/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

J-14 Bandera County-Other - Additional Wells to Provide Emergency Supply to VFD

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$1,199,000
Storage Tanks (Other Than at Booster Pump Stations)	$4,094,000
Water Treatment Plant (0.2 MGD)	$39,000
TOTAL COST OF FACILITIES	**$5,332,000**
- Planning (3%)	$160,000
- Design (7%)	$373,000
- Construction Engineering (1%)	$53,000
Legal Assistance (2%)	$107,000
Fiscal Services (2%)	$107,000
All Other Facilities Contingency (20%)	$1,066,000
Environmental & Archaeology Studies and Mitigation	$47,000
Land Acquisition and Surveying (3 acres)	$45,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$237,000
TOTAL COST OF PROJECT	**$7,527,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$530,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$53,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$23,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (111732 kW-hr @ 0.09 $/kW-hr)	$10,000
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$616,000**
Available Project Yield (acft/yr)	189
Annual Cost of Water ($ per acft), based on PF=0	$3,259

Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$455
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$10.00
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$1.40
JKJ	*1/22/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
J-17 Bandera County Irrigation - Additional Groundwater Wells

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$254,000
TOTAL COST OF FACILITIES	**$254,000**
- Planning (3%)	$8,000
- Design (7%)	$18,000
- Construction Engineering (1%)	$3,000
Legal Assistance (2%)	$5,000
Fiscal Services (2%)	$5,000
All Other Facilities Contingency (20%)	$51,000
Environmental & Archaeology Studies and Mitigation	$20,000
Land Acquisition and Surveying (2 acres)	$22,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$13,000
TOTAL COST OF PROJECT	**$399,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$28,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$3,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (34481 kW-hr @ 0.09 $/kW-hr)	$3,000
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$34,000**
Available Project Yield (acft/yr)	75
Annual Cost of Water ($ per acft), based on PF=0	$453
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$80
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.39
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.25

JKJ *1/22/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
J-19 Bandera County Livestock - Additional Groundwater Wells

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$439,000
TOTAL COST OF FACILITIES	**$439,000**
- Planning (3%)	$13,000
- Design (7%)	$31,000
- Construction Engineering (1%)	$4,000
Legal Assistance (2%)	$9,000
Fiscal Services (2%)	$9,000
All Other Facilities Contingency (20%)	$88,000
Environmental & Archaeology Studies and Mitigation	$27,000
Land Acquisition and Surveying (2 acres)	$29,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$22,000
TOTAL COST OF PROJECT	**$671,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$47,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$4,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (5567 kW-hr @ 0.09 $/kW-hr)	$1,000
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$52,000**
Available Project Yield (acft/yr)	8
Annual Cost of Water ($ per acft), based on PF=0	$6,500
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$625
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$19.94
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$1.92

JKJ *1/22/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
J-21 City of Rocksprings - Water Loss Audit & Main-Line Repair

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	*Estimated Costs for Facilities*
Conservation (Leaking Pipe/Meter Replacement)	$1,612,000
TOTAL COST OF FACILITIES	**$1,612,000**
- Planning (3%)	$48,000
- Design (7%)	$113,000
- Construction Engineering (1%)	$16,000
Legal Assistance (2%)	$32,000
Fiscal Services (2%)	$32,000
Pipeline Contingency (15%)	$242,000
Interest During Construction (3.5% for 0.5 years with a 0.5% ROI)	$35,000
TOTAL COST OF PROJECT	**$2,130,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$150,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$150,000**
Available Project Yield (acft/yr)	5
Annual Cost of Water ($ per acft), based on PF=0	$30,000
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$0
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$92.05
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.00

JKJ *1/22/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

J-22 City of Rocksprings - Additional Groundwater Well

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$686,000
Water Treatment Plant (0.2 MGD)	$39,000
TOTAL COST OF FACILITIES	**$725,000**
- Planning (3%)	$22,000
- Design (7%)	$51,000
- Construction Engineering (1%)	$7,000
Legal Assistance (2%)	$14,000
Fiscal Services (2%)	$14,000
All Other Facilities Contingency (20%)	$145,000
Environmental & Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (1 acres)	$3,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$33,000
TOTAL COST OF PROJECT	**$1,020,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$72,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$7,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$23,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (3 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$102,000**
Available Project Yield (acft/yr)	121
Annual Cost of Water ($ per acft), based on PF=0	$843
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$248

Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.59
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.76
JKJ	*1/22/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

J-23 Edwards County-Other (Barksdale WSC) - Additional Groundwater Well & RO Treatment

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$146,000
Advanced Water Treatment Facility (0.05 MGD)	$78,000
TOTAL COST OF FACILITIES	**$224,000**
- Planning (3%)	$7,000
- Design (7%)	$16,000
- Construction Engineering (1%)	$2,000
Legal Assistance (2%)	$4,000
Fiscal Services (2%)	$4,000
All Other Facilities Contingency (20%)	$45,000
Environmental & Archaeology Studies and Mitigation	$3,000
Land Acquisition and Surveying (1 acres)	$2,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$10,000
TOTAL COST OF PROJECT	**$317,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$22,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$1,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$39,000
Pumping Energy Costs (5585 kW-hr @ 0.09 $/kW-hr)	$1,000
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$63,000**
Available Project Yield (acft/yr)	54
Annual Cost of Water ($ per acft), based on PF=0	$1,167
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$759

Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$3.58
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$2.33
Note: One or more cost element has been calculated externally	
JKJ	*1/22/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
J-28 Edwards County Mining - Additional Groundwater Well

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$109,000
TOTAL COST OF FACILITIES	**$109,000**
- Planning (3%)	$3,000
- Design (7%)	$8,000
- Construction Engineering (1%)	$1,000
Legal Assistance (2%)	$2,000
Fiscal Services (2%)	$2,000
All Other Facilities Contingency (20%)	$22,000
Environmental & Archaeology Studies and Mitigation	$1,000
Land Acquisition and Surveying (1 acres)	$1,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$5,000
TOTAL COST OF PROJECT	**$154,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$11,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$1,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (6986 kW-hr @ 0.09 $/kW-hr)	$1,000
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$13,000**
Available Project Yield (acft/yr)	16
Annual Cost of Water ($ per acft), based on PF=0	$813
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$125
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.49
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.38

JKJ *1/23/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
J-29 City of Kerrville - Increase Wastewater Reuse

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Terminal Storage (Conservation Pool 300 acft, 30 acres)	$16,428,000
TOTAL COST OF FACILITIES	**$16,428,000**
- Planning (3%)	$493,000
- Design (7%)	$1,150,000
- Construction Engineering (1%)	$164,000
Legal Assistance (2%)	$329,000
Fiscal Services (2%)	$329,000
All Other Facilities Contingency (20%)	$3,286,000
Environmental & Archaeology Studies and Mitigation	$219,000
Land Acquisition and Surveying (30 acres)	$221,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$736,000
TOTAL COST OF PROJECT	**$23,355,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$1,094,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$246,000
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$1,340,000**
Available Project Yield (acft/yr)	2,500
Annual Cost of Water ($ per acft), based on PF=1.5	$536
Annual Cost of Water After Debt Service ($ per acft), based on PF=1.5	$98
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$1.64
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$0.30

JKJ *1/23/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
J-30 City of Kerrville - Water Loss Audit & Main-Line Repair

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Conservation (Leaking Pipe/Meter Replacement)	$21,767,000
TOTAL COST OF FACILITIES	**$21,767,000**
- Planning (3%)	$653,000
- Design (7%)	$1,524,000
- Construction Engineering (1%)	$218,000
Legal Assistance (2%)	$435,000
Fiscal Services (2%)	$435,000
Pipeline Contingency (15%)	$3,265,000
Interest During Construction (3.5% for 0.5 years with a 0.5% ROI)	$460,000
TOTAL COST OF PROJECT	**$28,757,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$2,023,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$2,023,000**
Available Project Yield (acft/yr)	42
Annual Cost of Water ($ per acft), based on PF=0	$48,167
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$0
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$147.80
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.00

JKJ *1/23/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

J-31 City of Kerrville - Additional Groundwater Well

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Intake Pump Stations (1.5 MGD)	$4,116,000
Transmission Pipeline (12 in. dia., 16 miles)	$22,468,000
Well Fields (Wells, Pumps, and Piping)	$1,381,000
Water Treatment Plant (0.9 MGD)	$94,000
TOTAL COST OF FACILITIES	**$28,059,000**
- Planning (3%)	$842,000
- Design (7%)	$1,964,000
- Construction Engineering (1%)	$281,000
Legal Assistance (2%)	$561,000
Fiscal Services (2%)	$561,000
Pipeline Contingency (15%)	$3,370,000
All Other Facilities Contingency (20%)	$1,118,000
Environmental & Archaeology Studies and Mitigation	$524,000
Land Acquisition and Surveying (6 acres)	$48,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$1,214,000
TOTAL COST OF PROJECT	**$38,542,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$2,712,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$238,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$103,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$57,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (351347 kW-hr @ 0.09 $/kW-hr)	$32,000
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$3,142,000**

Available Project Yield (acft/yr)	1,156
Annual Cost of Water ($ per acft), based on PF=1.5	$2,718
Annual Cost of Water After Debt Service ($ per acft), based on PF=1.5	$372
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$8.34
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$1.14
JKJ	*1/23/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
J-32 City of Kerrville - Increased Water Treatment and ASR

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$5,597,000
Water Treatment Plant (2 MGD)	$9,889,000
TOTAL COST OF FACILITIES	**$15,486,000**
- Planning (3%)	$465,000
- Design (7%)	$1,084,000
- Construction Engineering (1%)	$155,000
Legal Assistance (2%)	$310,000
Fiscal Services (2%)	$310,000
All Other Facilities Contingency (20%)	$3,097,000
Environmental & Archaeology Studies and Mitigation	$33,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$681,000
TOTAL COST OF PROJECT	**$21,621,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,521,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$56,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$893,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (1157507 kW-hr @ 0.09 $/kW-hr)	$104,000
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$2,574,000**
Available Project Yield (acft/yr)	3,360
Annual Cost of Water ($ per acft), based on PF=0	$766
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$313
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.35
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.96

JKJ *1/23/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

J-33 Kerrville South Water - Additional Groundwater Wells

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$902,000
Storage Tanks (Other Than at Booster Pump Stations)	$593,000
Water Treatment Plant (0.3 MGD)	$47,000
TOTAL COST OF FACILITIES	**$1,542,000**
- Planning (3%)	$46,000
- Design (7%)	$108,000
- Construction Engineering (1%)	$15,000
Legal Assistance (2%)	$31,000
Fiscal Services (2%)	$31,000
All Other Facilities Contingency (20%)	$309,000
Environmental & Archaeology Studies and Mitigation	$32,000
Land Acquisition and Surveying (3 acres)	$25,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$70,000
TOTAL COST OF PROJECT	**$2,209,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$155,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$15,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$28,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (43694 kW-hr @ 0.09 $/kW-hr)	$4,000
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$202,000**
Available Project Yield (acft/yr)	200
Annual Cost of Water ($ per acft), based on PF=0	$1,010

Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$235
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$3.10
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.72
JKJ	*1/22/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

J-34 Kerr County-Other (EKCRWSP) - Project 1 - Construction of Ellenburger Aquifer Well

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$568,000
Water Treatment Plant (0.1 MGD)	$31,000
TOTAL COST OF FACILITIES	**$599,000**
- Planning (3%)	$18,000
- Design (7%)	$42,000
- Construction Engineering (1%)	$6,000
Legal Assistance (2%)	$12,000
Fiscal Services (2%)	$12,000
All Other Facilities Contingency (20%)	$120,000
Environmental & Archaeology Studies and Mitigation	$64,000
Land Acquisition and Surveying (1 acres)	$4,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$29,000
TOTAL COST OF PROJECT	**$906,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$64,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$6,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$18,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (95508 kW-hr @ 0.09 $/kW-hr)	$9,000
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$97,000**
Available Project Yield (acft/yr)	108
Annual Cost of Water ($ per acft), based on PF=1.5	$898
Annual Cost of Water After Debt Service ($ per acft), based on PF=1.5	$306

Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$2.76
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$0.94
JKJ	*1/23/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
J-34 EKCRWSP - Project 2a Construction of Off Channel Surface Water Storage

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Off-Channel Storage/Ring Dike (Conservation Pool 2286 acft, 1500 acres)	$11,716,000
TOTAL COST OF FACILITIES	**$11,716,000**
- Planning (3%)	$351,000
- Design (7%)	$820,000
- Construction Engineering (1%)	$117,000
Legal Assistance (2%)	$234,000
Fiscal Services (2%)	$234,000
All Other Facilities Contingency (20%)	$2,343,000
Environmental & Archaeology Studies and Mitigation	$10,959,000
Land Acquisition and Surveying (1500 acres)	$11,049,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$1,230,000
TOTAL COST OF PROJECT	**$39,053,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$1,829,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$176,000
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$2,005,000**
Available Project Yield (acft/yr)	1,121
Annual Cost of Water ($ per acft), based on PF=0	$1,789
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$157
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$5.49
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.48

JKJ *1/23/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

J-34 EKCRWSP - Project 2b. Surface Water Treatment & Transmission Line

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	*Estimated Costs for Facilities*
Intake Pump Stations (1.5 MGD)	$6,725,000
Storage Tanks (Other Than at Booster Pump Stations)	$5,118,000
Water Treatment Plant (0.2 MGD)	$22,916,000
Integration, Relocations, Backup Generator & Other	$22,000
TOTAL COST OF FACILITIES	**$34,781,000**
- Planning (3%)	$1,043,000
- Design (7%)	$2,435,000
- Construction Engineering (1%)	$348,000
Legal Assistance (2%)	$696,000
Fiscal Services (2%)	$696,000
All Other Facilities Contingency (20%)	$6,956,000
Environmental & Archaeology Studies and Mitigation	$150,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$1,531,000
TOTAL COST OF PROJECT	**$48,636,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$3,420,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$51,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$168,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$204,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (354865 kW-hr @ 0.09 $/kW-hr)	$32,000
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$3,875,000**
Available Project Yield (acft/yr)	1,121
Annual Cost of Water ($ per acft), based on PF=1.5	$3,457

Annual Cost of Water After Debt Service ($ per acft), based on PF=1.5	$406
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$10.61
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$1.25
Note: One or more cost element has been calculated externally	
JKJ	*1/24/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
J-34 EKCRWSP - Project 3 Construction of ASR

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,350,000
TOTAL COST OF FACILITIES	**$1,350,000**
- Planning (3%)	$40,000
- Design (7%)	$94,000
- Construction Engineering (1%)	$13,000
Legal Assistance (2%)	$27,000
Fiscal Services (2%)	$27,000
All Other Facilities Contingency (20%)	$270,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$60,000
TOTAL COST OF PROJECT	**$1,881,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$132,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$13,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$145,000**
Available Project Yield (acft/yr)	1,124
Annual Cost of Water ($ per acft), based on PF=0	$129
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$12
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$0.40
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.04

Note: One or more cost element has been calculated externally

JKJ *1/24/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
J-34 EKCRWSP - Project 4a Trinity Aquifer Wellfield

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	*Estimated Costs for Facilities*
Intake Pump Stations (1.2 MGD)	$5,365,000
Well Fields (Wells, Pumps, and Piping)	$3,726,000
Water Treatment Plant (1.2 MGD)	$115,000
Integration, Relocations, Backup Generator & Other	$14,000
TOTAL COST OF FACILITIES	**$9,220,000**
- Planning (3%)	$277,000
- Design (7%)	$645,000
- Construction Engineering (1%)	$92,000
Legal Assistance (2%)	$184,000
Fiscal Services (2%)	$184,000
All Other Facilities Contingency (20%)	$1,844,000
Environmental & Archaeology Studies and Mitigation	$210,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$411,000
TOTAL COST OF PROJECT	**$13,067,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$919,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$37,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$134,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$69,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (224010 kW-hr @ 0.09 $/kW-hr)	$20,000
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$1,179,000**
Available Project Yield (acft/yr)	860
Annual Cost of Water ($ per acft), based on PF=1.5	$1,371

Annual Cost of Water After Debt Service ($ per acft), based on PF=1.5	$302
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$4.21
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$0.93
Note: One or more cost element has been calculated externally	
JKJ	*1/24/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

J-34 EKCRWSP - Project 4b Desalination Plant

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Intake Pump Stations (1.2 MGD)	$5,365,000
Two Water Treatment Plants (1.2 MGD and 1.2 MGD)	$31,212,000
Integration, Relocations, Backup Generator & Other	$1,255,000
TOTAL COST OF FACILITIES	**$37,832,000**
- Planning (3%)	$1,135,000
- Design (7%)	$2,648,000
- Construction Engineering (1%)	$378,000
Legal Assistance (2%)	$757,000
Fiscal Services (2%)	$757,000
All Other Facilities Contingency (20%)	$7,566,000
Environmental & Archaeology Studies and Mitigation	$150,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$1,665,000
TOTAL COST OF PROJECT	**$52,888,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$3,720,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$13,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$134,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$5,231,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (224010 kW-hr @ 0.09 $/kW-hr)	$20,000
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$9,118,000**
Available Project Yield (acft/yr)	860
Annual Cost of Water ($ per acft), based on PF=1.5	$10,602
Annual Cost of Water After Debt Service ($ per acft), based on PF=1.5	$6,277

Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$32.53
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$19.26
Note: One or more cost element has been calculated externally	
JKJ	*1/24/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

J-35 Kerr County-Other (Center Point) - Purchase Water from EKCRWSP

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (11 acft/yr @ 1136 $/acft)	$12,000
TOTAL ANNUAL COST	**$12,000**
Available Project Yield (acft/yr)	11
Annual Cost of Water ($ per acft), based on PF=0	$1,091
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$1,091
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$3.35
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$3.35

JKJ *1/24/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

J-36 Kerr County-Other (Center Point Taylor System) - Purchase Water from EKCRWSP

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	*Estimated Costs for Facilities*
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (43 acft/yr @ 1136 $/acft)	$49,000
TOTAL ANNUAL COST	**$49,000**
Available Project Yield (acft/yr)	43
Annual Cost of Water ($ per acft), based on PF=0	$1,140
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$1,140
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$3.50
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$3.50

JKJ *1/24/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
J-37 Kerr County-Other (Community Water Group WSC) - Water Loss Audit & Main-Line Repair

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Conservation (Leaking Pipe/Meter Replacement)	$806,000
TOTAL COST OF FACILITIES	**$806,000**
- Planning (3%)	$24,000
- Design (7%)	$56,000
- Construction Engineering (1%)	$8,000
Legal Assistance (2%)	$16,000
Fiscal Services (2%)	$16,000
Pipeline Contingency (15%)	$121,000
Interest During Construction (3.5% for 0.5 years with a 0.5% ROI)	$18,000
TOTAL COST OF PROJECT	**$1,065,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$75,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$75,000**
Available Project Yield (acft/yr)	1
Annual Cost of Water ($ per acft), based on PF=0	$75,000
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$0
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$230.13
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.00

JKJ *1/24/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

J-38 Kerr County-Other - Purchase Water from EKCRWSP

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (102 acft/yr @ 1136 $/acft)	$116,000
TOTAL ANNUAL COST	**$116,000**
Available Project Yield (acft/yr)	102
Annual Cost of Water ($ per acft), based on PF=0	$1,137
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$1,137
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$3.49
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$3.49

JKJ *1/24/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
J-43 Kerr County Livestock (Colorado Basin) - Additional Groundwater Wells

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$226,000
TOTAL COST OF FACILITIES	**$226,000**
- Planning (3%)	$7,000
- Design (7%)	$16,000
- Construction Engineering (1%)	$2,000
Legal Assistance (2%)	$5,000
Fiscal Services (2%)	$5,000
All Other Facilities Contingency (20%)	$45,000
Environmental & Archaeology Studies and Mitigation	$2,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$10,000
TOTAL COST OF PROJECT	**$318,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$22,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$2,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (2128 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$24,000**
Available Project Yield (acft/yr)	24
Annual Cost of Water ($ per acft), based on PF=0	$1,000
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$83
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$3.07
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.26

JKJ *1/24/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
J-45 Kerr County Livestock (San Antonio Basin) - Additional Groundwater Wells

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$181,000
TOTAL COST OF FACILITIES	**$181,000**
- Planning (3%)	$5,000
- Design (7%)	$13,000
- Construction Engineering (1%)	$2,000
Legal Assistance (2%)	$4,000
Fiscal Services (2%)	$4,000
All Other Facilities Contingency (20%)	$36,000
Environmental & Archaeology Studies and Mitigation	$2,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$8,000
TOTAL COST OF PROJECT	**$255,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$18,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$2,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (47754 kW-hr @ 0.09 $/kW-hr)	$4,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$24,000**
Available Project Yield (acft/yr)	54
Annual Cost of Water ($ per acft), based on PF=0	$444
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$111
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.36
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.34

JKJ *1/24/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
J-47 Kerr County Mining (Guadalupe Basin) - Additional Groundwater Wells

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$255,000
TOTAL COST OF FACILITIES	**$255,000**
- Planning (3%)	$8,000
- Design (7%)	$18,000
- Construction Engineering (1%)	$3,000
Legal Assistance (2%)	$5,000
Fiscal Services (2%)	$5,000
All Other Facilities Contingency (20%)	$51,000
Environmental & Archaeology Studies and Mitigation	$3,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$12,000
TOTAL COST OF PROJECT	**$360,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$25,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$3,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (41029 kW-hr @ 0.09 $/kW-hr)	$4,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$32,000**
Available Project Yield (acft/yr)	48
Annual Cost of Water ($ per acft), based on PF=0	$667
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$146
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.05
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.45

JKJ *1/24/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

J-48 City of Brackettville - Increase Supply to Spofford with New Water Line

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	*Estimated Costs for Facilities*
Transmission Pipeline (6 in. dia., 10.5 miles)	$8,465,000
Storage Tanks (Other Than at Booster Pump Stations)	$1,024,000
TOTAL COST OF FACILITIES	**$9,489,000**
- Planning (3%)	$285,000
- Design (7%)	$664,000
- Construction Engineering (1%)	$95,000
Legal Assistance (2%)	$190,000
Fiscal Services (2%)	$190,000
Pipeline Contingency (15%)	$1,270,000
All Other Facilities Contingency (20%)	$205,000
Environmental & Archaeology Studies and Mitigation	$320,000
Land Acquisition and Surveying (32 acres)	$72,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$416,000
TOTAL COST OF PROJECT	**$13,196,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$928,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$95,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (523 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$1,023,000**
Available Project Yield (acft/yr)	3
Annual Cost of Water ($ per acft), based on PF=1.5	$341,000

Annual Cost of Water After Debt Service ($ per acft), based on PF=1.5	$31,667
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$1,046.33
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$97.17
JKJ	*1/24/2025*

Cost Estimate Summary Water Supply Project Option September 2023 Prices J-49 City of Brackettville - Increase Storage Facility	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Storage Tanks (Other Than at Booster Pump Stations)	$1,024,000
TOTAL COST OF FACILITIES	**$1,024,000**
- Planning (3%)	$31,000
- Design (7%)	$72,000
- Construction Engineering (1%)	$10,000
Legal Assistance (2%)	$20,000
Fiscal Services (2%)	$20,000
All Other Facilities Contingency (20%)	$205,000
Environmental & Archaeology Studies and Mitigation	$5,000
Land Acquisition and Surveying (2 acres)	$5,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$46,000
TOTAL COST OF PROJECT	**$1,438,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$101,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$10,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$111,000**
Available Project Yield (acft/yr)	3
Annual Cost of Water ($ per acft), based on PF=0	$37,000
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$3,333
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$113.53
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$10.23
JKJ	*1/24/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
J-50 Fort Clark Springs MUD - Increase Storage Facility

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Storage Tanks (Other Than at Booster Pump Stations)	$1,784,000
TOTAL COST OF FACILITIES	**$1,784,000**
- Planning (3%)	$54,000
- Design (7%)	$125,000
- Construction Engineering (1%)	$18,000
Legal Assistance (2%)	$36,000
Fiscal Services (2%)	$36,000
All Other Facilities Contingency (20%)	$357,000
Environmental & Archaeology Studies and Mitigation	$5,000
Land Acquisition and Surveying (2 acres)	$5,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$79,000
TOTAL COST OF PROJECT	**$2,499,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$176,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$18,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$194,000**
Available Project Yield (acft/yr)	620
Annual Cost of Water ($ per acft), based on PF=0	$313
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$29
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$0.96
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.09

JKJ *1/25/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

J-54 City of Camp Wood - Additional Groundwater Wells

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,790,000
TOTAL COST OF FACILITIES	**$1,790,000**
- Planning (3%)	$54,000
- Design (7%)	$125,000
- Construction Engineering (1%)	$18,000
Legal Assistance (2%)	$36,000
Fiscal Services (2%)	$36,000
All Other Facilities Contingency (20%)	$358,000
Environmental & Archaeology Studies and Mitigation	$18,000
Land Acquisition and Surveying (2 acres)	$16,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$80,000
TOTAL COST OF PROJECT	**$2,531,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$178,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$18,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (150730 kW-hr @ 0.09 $/kW-hr)	$14,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$210,000**
Available Project Yield (acft/yr)	258
Annual Cost of Water ($ per acft), based on PF=0	$814
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$124
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.50

Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.38
JKJ	*1/24/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

J-56 City of Leakey - Additional Groundwater Well

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$424,000
Water Treatment Plant (0.1 MGD)	$31,000
TOTAL COST OF FACILITIES	**$455,000**
- Planning (3%)	$14,000
- Design (7%)	$32,000
- Construction Engineering (1%)	$5,000
Legal Assistance (2%)	$9,000
Fiscal Services (2%)	$9,000
All Other Facilities Contingency (20%)	$91,000
Environmental & Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (1 acres)	$4,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$21,000
TOTAL COST OF PROJECT	**$646,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$45,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$4,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$18,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (80506 kW-hr @ 0.09 $/kW-hr)	$7,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$74,000**
Available Project Yield (acft/yr)	91
Annual Cost of Water ($ per acft), based on PF=0	$813
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$319

Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.50
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.98
JKJ	*1/24/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
J-57 City of Leakey - Develop Interconnections between Wells

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$534,000
TOTAL COST OF FACILITIES	**$534,000**
- Planning (3%)	$16,000
- Design (7%)	$37,000
- Construction Engineering (1%)	$5,000
Legal Assistance (2%)	$11,000
Fiscal Services (2%)	$11,000
All Other Facilities Contingency (20%)	$107,000
Environmental & Archaeology Studies and Mitigation	$32,000
Land Acquisition and Surveying (2 acres)	$13,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$25,000
TOTAL COST OF PROJECT	**$791,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$56,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$5,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$61,000**
Available Project Yield (acft/yr)	81
Annual Cost of Water ($ per acft), based on PF=0	$753
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$62
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.31
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.19

JKJ *1/24/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
J-58 Real County-Other (Real WSC) - Water Loss Audit & Main-Line Repair

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	*Estimated Costs for Facilities*
Conservation (Leaking Pipe/Meter Replacement)	$806,000
TOTAL COST OF FACILITIES	**$806,000**
- Planning (3%)	$24,000
- Design (7%)	$56,000
- Construction Engineering (1%)	$8,000
Legal Assistance (2%)	$16,000
Fiscal Services (2%)	$16,000
Pipeline Contingency (15%)	$121,000
Interest During Construction (3.5% for 0.5 years with a 0.5% ROI)	$18,000
TOTAL COST OF PROJECT	**$1,065,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$75,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$75,000**
Available Project Yield (acft/yr)	1
Annual Cost of Water ($ per acft), based on PF=0	$75,000
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$0
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$230.13
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.00

JKJ *1/24/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
J-59 Real County-Other (Oakmont Saddle Mountain WSC) - Additional Groundwater Well

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$441,000
TOTAL COST OF FACILITIES	**$441,000**
- Planning (3%)	$13,000
- Design (7%)	$31,000
- Construction Engineering (1%)	$4,000
Legal Assistance (2%)	$9,000
Fiscal Services (2%)	$9,000
All Other Facilities Contingency (20%)	$88,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$20,000
TOTAL COST OF PROJECT	**$615,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$43,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$4,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$47,000**
Available Project Yield (acft/yr)	54
Annual Cost of Water ($ per acft), based on PF=0	$870
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$74
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.67
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.23

Note: One or more cost element has been calculated externally

JKJ *1/24/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
J-62 City of Del Rio - Water Loss Audit & Main-Line Repair

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023

Item	*Estimated Costs for Facilities*
Conservation (Leaking Pipe/Meter Replacement)	$67,720,000
TOTAL COST OF FACILITIES	**$67,720,000**
- Planning (3%)	$2,032,000
- Design (7%)	$4,740,000
- Construction Engineering (1%)	$677,000
Legal Assistance (2%)	$1,354,000
Fiscal Services (2%)	$1,354,000
Pipeline Contingency (15%)	$10,158,000
Interest During Construction (3.5% for 0.5 years with a 0.5% ROI)	$1,431,000
TOTAL COST OF PROJECT	**$89,466,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$6,295,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$6,295,000**
Available Project Yield (acft/yr)	631
Annual Cost of Water ($ per acft), based on PF=0	$9,976
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$0
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$30.61
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.00

JKJ *1/26/2025*

Cost Estimate Summary *Water Supply Project Option* *September 2023 Prices* *J-63 City of Del Rio - Additional Groundwater Well*	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (9.6 MGD)	$12,297,000
Well Fields (Wells, Pumps, and Piping)	$1,790,000
Integration, Relocations, Backup Generator & Other	$79,000
TOTAL COST OF FACILITIES	**$14,166,000**
- Planning (3%)	$425,000
- Design (7%)	$992,000
- Construction Engineering (1%)	$142,000
Legal Assistance (2%)	$283,000
Fiscal Services (2%)	$283,000
All Other Facilities Contingency (20%)	$2,833,000
Environmental & Archaeology Studies and Mitigation	$19,000
Land Acquisition and Surveying (6 acres)	$1,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$620,000
TOTAL COST OF PROJECT	**$19,764,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,385,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$19,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$307,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (4372826 kW-hr @ 0.09 $/kW-hr)	$394,000
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$2,105,000**
Available Project Yield (acft/yr)	7,191
Annual Cost of Water ($ per acft), based on PF=1.5	$293

Annual Cost of Water After Debt Service ($ per acft), based on PF=1.5	$100
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$0.90
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$0.31
JKJ	*1/26/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

J-64 City of Del Rio - Water Treatment Plant Expansion

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023

Item	*Estimated Costs for Facilities*
Water Treatment Plant (1 MGD)	$7,523,000
TOTAL COST OF FACILITIES	**$7,523,000**
- Planning (3%)	$226,000
- Design (7%)	$527,000
- Construction Engineering (1%)	$75,000
Legal Assistance (2%)	$150,000
Fiscal Services (2%)	$150,000
All Other Facilities Contingency (20%)	$1,505,000
Environmental & Archaeology Studies and Mitigation	$1,000
Land Acquisition and Surveying (1 acres)	$1,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$331,000
TOTAL COST OF PROJECT	**$10,489,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$738,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$752,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$1,490,000**
Available Project Yield (acft/yr)	943
Annual Cost of Water ($ per acft), based on PF=0	$1,580
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$797
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$4.85

Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$2.45
JKJ	*1/26/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

J-65 City of Del Rio - Develop a Wastewater Reuse Program

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Transmission Pipeline (6 in. dia., 10.2 miles)	$8,245,000
TOTAL COST OF FACILITIES	**$8,245,000**
- Planning (3%)	$247,000
- Design (7%)	$577,000
- Construction Engineering (1%)	$82,000
Legal Assistance (2%)	$165,000
Fiscal Services (2%)	$165,000
Pipeline Contingency (15%)	$1,237,000
Environmental & Archaeology Studies and Mitigation	$307,000
Land Acquisition and Surveying (25 acres)	$65,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$361,000
TOTAL COST OF PROJECT	**$11,451,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$806,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$82,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$888,000**
Available Project Yield (acft/yr)	3,092
Annual Cost of Water ($ per acft), based on PF=0	$287
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$27
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$0.88

Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.08
JKJ	*1/26/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
J-66 Val Verde County-Other (San Pedro Canyon Subdivision) - Water Loss Audit & Main-Line Repair

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Conservation (Leaking Pipe/Meter Replacement)	$806,000
TOTAL COST OF FACILITIES	**$806,000**
- Planning (3%)	$24,000
- Design (7%)	$56,000
- Construction Engineering (1%)	$8,000
Legal Assistance (2%)	$16,000
Fiscal Services (2%)	$16,000
Pipeline Contingency (15%)	$121,000
Interest During Construction (3.5% for 0.5 years with a 0.5% ROI)	$18,000
TOTAL COST OF PROJECT	**$1,065,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$75,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$75,000**
Available Project Yield (acft/yr)	3
Annual Cost of Water ($ per acft), based on PF=0	$25,000
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$0
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$76.71
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.00

JKJ *1/24/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
J-67 Val Verde County-Other (Tierra Del Lago) - Water Loss Audit & Main-Line Repair

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Conservation (Leaking Pipe/Meter Replacement)	$806,000
TOTAL COST OF FACILITIES	**$806,000**
- Planning (3%)	$24,000
- Design (7%)	$56,000
- Construction Engineering (1%)	$8,000
Legal Assistance (2%)	$16,000
Fiscal Services (2%)	$16,000
Pipeline Contingency (15%)	$121,000
Interest During Construction (3.5% for 0.5 years with a 0.5% ROI)	$18,000
TOTAL COST OF PROJECT	**$1,065,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$75,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (0 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$75,000**
Available Project Yield (acft/yr)	5
Annual Cost of Water ($ per acft), based on PF=0	$15,000
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$0
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$46.03
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.00

JKJ *1/24/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

J-70 Val Verde County Mining - Additional Groundwater Wells

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$959,000
TOTAL COST OF FACILITIES	**$959,000**
- Planning (3%)	$29,000
- Design (7%)	$67,000
- Construction Engineering (1%)	$10,000
Legal Assistance (2%)	$19,000
Fiscal Services (2%)	$19,000
All Other Facilities Contingency (20%)	$192,000
Environmental & Archaeology Studies and Mitigation	$5,000
Land Acquisition and Surveying (2 acres)	$5,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$43,000
TOTAL COST OF PROJECT	**$1,348,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$95,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$10,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (99578 kW-hr @ 0.09 $/kW-hr)	$9,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$114,000**
Available Project Yield (acft/yr)	242
Annual Cost of Water ($ per acft), based on PF=0	$471
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$79
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.45
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.24

JKJ *1/26/2025*

CHAPTER 6

REGIONAL WATER PLAN IMPACTS AND CONSISTENCY WITH PROTECTION OF WATER, AGRICULTURAL AND NATURAL RESOURCES

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6 REGIONAL WATER PLAN IMPACTS AND CONSISTENCY WITH PROTECTION OF WATER, AGRICULTURAL AND NATURAL RESOURCES

Chapter 6 describes how this *2026 Plan* is consistent with the long-term protection of water resources, agricultural resources, and natural resources that are important to the Plateau Region. All planning analyses applied, and recommendations made in the development of this *Plan* honor all existing water rights, contracts, and option agreements; and have no impact on navigation on any of the Region's surface water streams and rivers. Third-party social and economic impacts resulting from voluntary redistributions of water, including impacts of moving water from rural and agricultural areas were considered; however, no strategies were recommended that resulted in moving water from such areas.

The socioeconomic impact of not meeting water supply needs within the Region is discussed in an analysis report prepared by the Texas Water Development Board and presented in Appendix 6A at the end of this chapter. Based on projected water demands and existing water supplies, the Region identified water needs (potential shortages) that could occur under a repeat of the drought of record for six water use categories (county-other, irrigation, livestock, manufacturing, mining and municipal). The TWDB then estimated the annual socioeconomic impacts of those needs, if they are not met, for each water use category and as an aggregate for the Region.

The report describes that the Plateau Region generated more than $X billion in gross domestic product (2023 dollars) and supported roughly X jobs in 2023. It is estimated that not meeting the identified water needs in the Plateau Region would result in an annually combined lost income impact of approximately $X million in 2030, increasing to $X million in 2080. In 2030, the Region would lose approximately X jobs, and by 2080 job losses would increase to approximately X if anticipated needs are not mitigated.

6.1 PROTECTION OF WATER RESOURCES

Water resources in the Plateau Region as described in Chapter 3 include groundwater in numerous aquifers and surface water occurring in five rivers and their tributaries. The numerous springs, which represent an inter-relational transition point between groundwater and surface water, are also recognized in Chapter 1, Section 1.4.3 and Chapter 3, Section 3.3 for their major importance.

The first step in achieving long-term water resources protection was in the process of estimating each source's availability. Surface water estimates are developed through a WAM process and are based on the quantity of surface water available to meet existing water rights during a drought-of-record.

Groundwater availability estimates are based on the MAG volumes that may be produced on an average annual basis to achieve a DFC as adopted by GMAs. Establishing conservative levels of water source availability, thus results in less potential of over exploiting the supply.

The next step in establishing the long-term protection of water resources occurs in the water management strategies developed in Chapter 5 to meet potential water-supply shortages. Each strategy was evaluated for potential threats to water resources in terms of source depletion (reliability), quality degradation, and impact to environmental habitat.

Key parameters of water quality are discussed in Chapter 1 Section 1.4.5. The potential for surface water contamination resulting from urban runoff in rapidly growing population centers is of concern in the Plateau Region. Groundwater contamination most often results from old, poorly constructed, or new improperly constructed water wells. In both surface water and groundwater concerns, this *Plan* attempts to (1) provide the reader with information pertaining to best practices to prevent water contamination, (2) recognize local organizational (river authorities, ground water districts, etc.) practices and programs intended to prevent water contamination, and (3) present recommended water management strategies that do not result in potential contamination issues. It is the specific intent of the PWPG that Utilities and WUGs use all necessary precautions and follow all mandated guidelines in the construction of recommended water management strategies. In the analysis of potential water quality impact, no recommended strategies were determined to result in an anticipated water quality degradation.

Water conservation strategies are also recommended for each entity with a supply deficit. Conservation reduces the impact on water supplies by reducing the actual water demand for the supply. Table 5-2 and Table 5-4 in Chapter 5 provides an overview of these impact evaluations.

Chapters 5 and 7 contain information and recommendations pertaining to water conservation and drought management practices. When enacted, the conservation practices will diminish water demand, the drought management practices will extend supplies over the stress period, and the land management practices will potentially increase aquifer recharge.

6.2 PROTECTION OF AGRICULTURAL RESOURCES

Agriculture in the Plateau Region, as described in Chapter 1, Sections 1.2.8 and 1.3.3, and Chapter 3, Section 3.1.10 includes the raising of crops and livestock, as well as a multitude of businesses that support this industry. Many of the communities in the Region depend on various forms of the agricultural industry for a significant portion of their economy. It is thus important to the economic health and way of life in these communities to protect water resources that have historically been used in the support of agricultural activities.

TWDB's socio-economic analysis (Appendix 6A) reports that a projected water shortages in the irrigated agriculture water use category for one or more decades within the water planning horizon (Chapter 4, Table 4-1) occurs in Bandera, Edwards, and Kerr Counties. Per the TWDB's socio-economic analysis, a negative tax impact was surmised, primarily due to past subsidies from the Federal government.

Portions of three of the six counties in the Region (Bandera, Edwards and Kerr) are projected to experience water shortages in the livestock water use category for one or more decades within the water planning horizon (Chapter 4, Table 4-1). Income loss is estimated to be approximately $X million, which includes approximately X job losses per decade (Table 6-1).

The *2026 Plateau Region Water Plan* provides irrigation strategy recommendations for minor projected shortages in parts of Bandera, Edwards, and Kerr Counties in Chapter 5 and Appendix 5A and 5B. Also, non-agricultural strategies provided in Chapter 5 include an analysis of potential impact to agricultural interests.

An interim project was performed in 2010 to evaluate the water use by livestock and game animals in the Plateau Region. This report titled "Water Use by Livestock and Game Animals in the Plateau Regional Water Planning Area" is printed in the 2011 Plateau Water Plan.

Table 6-1. Impacts of Water Shortages on Irrigation and Livestock

WUG	2030	2040	2050	2060	2070	2080
Irrigation	$0	$0	$0	$0	$0	$0
Job Losses	0	0	0	0	0	0
Livestock	$11M	$11M	$11M	$11M	$11M	$11M
Job Losses	573	573	573	573	573	573

* Year 2023 dollars rounded.

6.3 PROTECTION OF NATURAL RESOURCES

The Plateau Region Water Planning Group has adopted a stance toward the protection of natural resources. Natural resources are defined in Chapter 1, Sections 1.2.6 and 1.2.8 as including terrestrial and aquatic habitats that support a diverse environmental community as well as provide recreational and economic opportunities. Environmental and recreational water needs are discussed in Chapter 2, Section 2.3.

The protection of natural resources is closely linked with the protection of water resources as discussed in Section 6.1 above. Where possible, the methodology used to assess groundwater source availability is based on not significantly lowering water levels to a point where spring flows might be impacted. Thus, the intention to protect surface flows is directly related to those natural resources that are dependent on surface water sources or spring flows for their existence.

Environmental impacts were evaluated in the consideration of strategies to meet water-supply deficits. Table 5-4 in Chapter 5 provides a comparative analysis of all selected strategies. Of prime consideration was whether a strategy potentially could diminish the quantity of water currently existing in the natural environment and if a strategy could impact water quality to a level that would be detrimental to animals and plants that naturally inhabit the area under consideration.

Although the Planning Group chooses to respect the privacy of private lands by not recommending "Ecologically Unique River and Stream Segments" in this *Plan,* the Group recognizes and applauds the conservation work that is undertaken daily by the majority of all landowners in the Region.

6.4 PROTECTION OF PUBLIC HEALTH AND SAFETY

Sufficient water management strategy supplies are recommended in this *2026 Plan* to meet the identified projected needs of all municipal WUGs in the Region except for:

- Irrigation in Bandera County.
- Livestock in Edwards County.
- Manufacturing in Real County.

The public health and safety of meeting municipal water-supply needs is of significant concern of the PWPG in preparing this *Plan*. The unmet needs listed above received attention in terms of considering additional conservation and infrastructure strategies.

Livestock use shortages in Edwards County is likely the result of GMA limitations on groundwater availability. Livestock supply use is considered “Exempt” from permitting but should consult with the local Groundwater Conservation Districts for advice on aquifer supply availability. During drought of record conditions, livestock is typically reduced to a manageable level which would likely eliminate the unmet needs condition. Public health and safety are not at risk because of unmet Livestock supply needs.

Irrigation use shortages in Bandera County is the result of limitations on groundwater availability. In addition, Bandera County has remained in critical drought conditions since the previous 2021 Plateau Water Plan. During significantly dry periods, insufficient water is available to meet the full permitted allotments, and farmers in these areas have generally approached this situation by reducing acreage irrigated, changing types of crops planted, or possibly not planting crops until water becomes available during the following season. More details have been provided in Chapter 5, Section 5.3.6.

Manufacturing use shortages and recommended conservation measures have been outlined in Chapter 5, Section 5.3.7. The PWPG does not anticipate amending the *2026 Plan* to address these unmet non-municipal needs but is prepared to do so if conditions cause an entity to request such a change.

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APPENDIX 6A
SOCIOECONOMIC IMPACT OF UNMET WATER NEEDS

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CHAPTER 7

DROUGHT RESPONSE INFORMATION, ACTIVITIES, AND RECOMMENDATIONS

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7 REGIONAL DROUGHT RESPONSE

Drought is a frequent and inevitable factor in the climate of Texas. The seven-year DOR in the 1950s was a turning point in Texas history that led to the development of the TWDB. Since then, Texas has faced numerous droughts, including the second worst and second-longest Statewide drought that began in August 2010 and lasted through October 2014. Widespread drought returned to much of the State in 2022, rivaling 2011 conditions and again illustrating drought's reoccurring threat to cause significant harm. Therefore, it is vital to plan for the effect that droughts will have on the use, allocation, and conservation of water in the State.

Drought management measures have been incorporated as an increasingly important part of water planning at the local, regional and Statewide levels. In 2009, the TWDB published Drought Management in the Texas Regional and State Water Planning Process, which examines the potential benefits and drawbacks of including drought management as a regional water management strategy.

Through the regional water planning process, requirements for drought management planning are found in Title 31 of the TAC, Part 10, Chapter 357, Subchapter D. Texas Statute reference §357.42 includes requirements regarding drought response information, activities, and recommendations. This chapter examines these specific requirements and identifies drought impacts within the Region.

7.1 DOR IN THE PLATEAU REGION

The severity of the most recent drought significantly impacted the lives of water users, providers and water managers who were hard-pressed to find solutions to critical supply and demand issues. The severity of the impacts varied, but the overriding sense of urgency to create workable strategies and solutions was acknowledged and acted upon Statewide. Therefore, it is critical in this planning cycle to continue to address the impact that drought has had and will continue to have on the future use, allocation, and conservation of water in the State.

There are different types of droughts that have been defined in various ways; however, these definitions fall into four primary categories: (1) meteorological, (2) agricultural, (3) hydrological and (4) socioeconomic drought. According to the American Meteorological Society, drought is a period of abnormally dry weather sufficiently long enough to cause a serious hydrological imbalance. The State Drought Preparedness Plan provides more specific and detailed definitions.

Meteorological drought is quantified by how dry it is (for example, a rain deficit) compared to normal conditions as well as the duration of the dry period. This is typically a region-specific metric, since factors affecting meteorological drought can vary so much in different regions. This type of drought does not necessarily impact water supply.

Agricultural drought looks at the effects of meteorological drought in terms of agricultural impacts. For example, evapotranspiration, soil moisture and plant stress are measures of agricultural drought, which account for vulnerability of crops through the various growth stages. This type of drought often leads to drought disaster declarations and, in many cases, is an indicator of an impending hydrological drought.

Hydrological drought is measured in terms of effects on surface and subsurface waters, such as reservoir stage and capacity, stream flow or groundwater levels in wells. Hydrological drought is usually defined on a river-basin or watershed scale. Hydrological droughts typically lag behind meteorological and agricultural droughts because it takes more time for the evidence of basin-wide impacts to manifest. This type of drought typically always impacts water supplies and is the focus of the TWDB's water planning process.

Socioeconomic drought occurs when physical water needs affect the health, safety, and quality of life of the general public or when the drought affects the supply and demand of an economic product. An example of socioeconomic drought is when the demand for an economic product (such as hydroelectric power) exceeds supply due to a weather-related deficit. Typically, demand for a product increases with population growth and per capita consumptions, and supply increases due to efficiency technology and the construction of new water projects. If both are increasing, the rate of change between supply and demand determines the level of socioeconomic drought. However, regardless of the rate of change, when demand exceeds supply, vulnerability is magnified by water shortages during drought.

Several climatological drought indicators have been formulated to quantify drought. The Palmer Drought Severity Index (PDSI) was developed in 1965 and is currently used by many Federal and State agencies. The PDSI attempts to measure the duration and intensity of the long-term drought-inducting circulation patterns. Long-term drought is cumulative, so the intensity of drought during the current month is dependent on the current weather patterns plus the cumulative patterns of previous months. PDSI values can lag oncoming drought by several months. The PDSI quantifies drought using values ranging between -6.0 (driest) to 6.0 (wettest), and the TWDB uses the PDSI to monitor State drought conditions "Extreme drought" conditions have a PDSI between -6.0 and -4.0, and "severe drought" conditions have a PDSI between -3.99 and -3.0.

An accumulated area graph of the weekly PDSI categories for the Edwards Plateau Region of Texas is included as Figure 7-1. Since 2000, the Plateau Region experienced recurring extreme drought conditions in 2006-2007, 2008-2009, 2011-2015, 2018-2019, and 2020-2024.

The Plateau Region experienced the longest sustained periods of extreme drought between November 2010 and May 2012, between September 2012 and May 2015, and between November 2022 and January 2024.

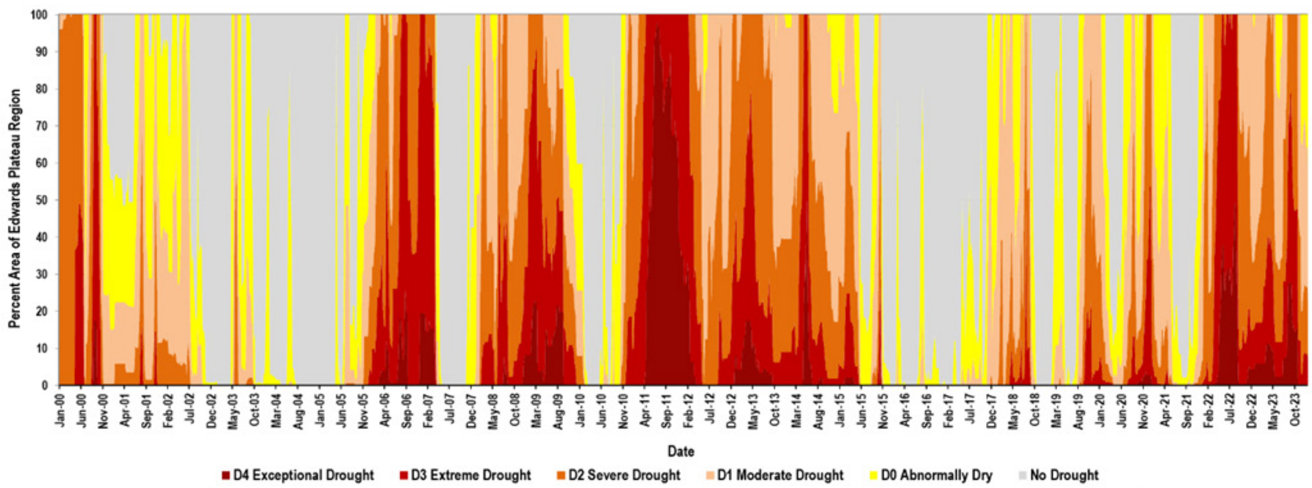

Figure 7-1. Drought in the Edwards Plateau Region of Texas, 2000-2023
Source: U.S. Drought Monitor

The climate of the Plateau Region is intermediate to the more humid climates of regions to the east and drier climates of regions to the west. The combination of high temperatures, high potential evapotranspiration and intermediate rainfall totals combine to produce a semi-arid climate with drought conditions during all or parts of some years (Bomar, 1995).

7.1.1 Precipitation Indicator

Although residents are generally accustomed to the highly variable climatic conditions typical of the Plateau Region, the relatively low rainfall and the accompanying high levels of evaporation underscore the necessity of developing plans that respond to potential disruptions in the supply of groundwater and surface water caused by drought conditions.

For this planning cycle, the drought of the 1950s is considered the DOR. The DOR and recent droughts can be compared using historic precipitation, stream flow records, spring discharge and water level measurements in wells for locations that have accumulated data measurements since the 1940s.

Precipitation data for quadrangles 807 (west Plateau Region - portions of Edwards, Kinney and Val Verde Counties) and 808 (east Plateau Region - portions of Bandera, Kerr, Real, and Medina Counties) from 1940 through 2023 are shown on Figure 7-2. Average annual rainfall for these quadrangles is 24.6 and 26.8 inches, respectively. These data indicate that the DOR in the 1950s was associated with seven years of below average rainfall (5-inch deficit per year). The most recent drought indicates a trend toward below average annual rainfall between 2018 and 2023. Years with below average rainfall have a deficit of about 8 to 10 inches for the year.

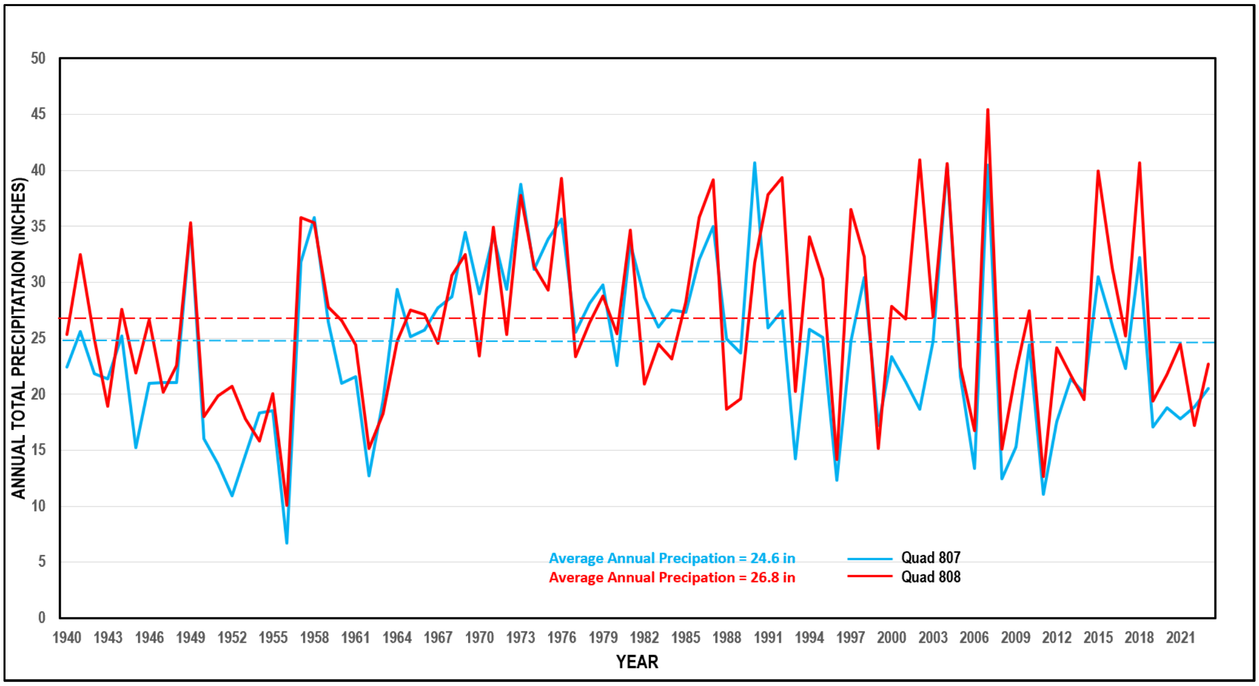

Figure 7-2. Annual Precipitation, 1940-2023
Source: TWDB

7.1.2 Stream Flow Indicator

The USGS has six stream gages located in or proximal to the Plateau Region that have flow data measurements extending back to 1943 (Figure 7-3). Graphs of the annual mean daily discharge (by calendar year) are presented with the average annual mean daily discharge, in cfs.

Some general comparisons can be made between the gaging stations during the DOR. It appears that the DOR affected stream flow in the Nueces River basin by 1950, whereas in the Frio and Guadalupe River basins, stream flow was not impacted until after 1950. Since the western counties in the Region average about two inches of rainfall less than the eastern counties, this impact lag is somewhat intuitive but worth noting, nonetheless. The stream flow data in the Frio, Sabinal and Guadalupe River basins illustrate this more readily than the gages located in the Nueces River basin. Additionally, the gaging data highlights the gradual decrease in stream flow that can be seen during the DOR in the 1950s compared to the sudden decrease of flow that is evident in the more recent flow data. These graphs show that recent stream flow in all river basins decreased suddenly compared to the DOR in the 1950s, and that the decreased flow occurred nearly simultaneously in all basins. Generally, it appears that the prolonged drought of 2022 is having a more intense and rapid impact on stream flow; however, it is uncertain what portion of the decrease in stream flow can be attributed to a decrease in base flow due to increased groundwater pumping. Also, except for perhaps the West Nueces River gaging station near Brackettville (the most arid station location), there does not appear to be a historical decrease in flow since year 2000 as has been observed in the Upper Colorado River basin (Figure 7-4).

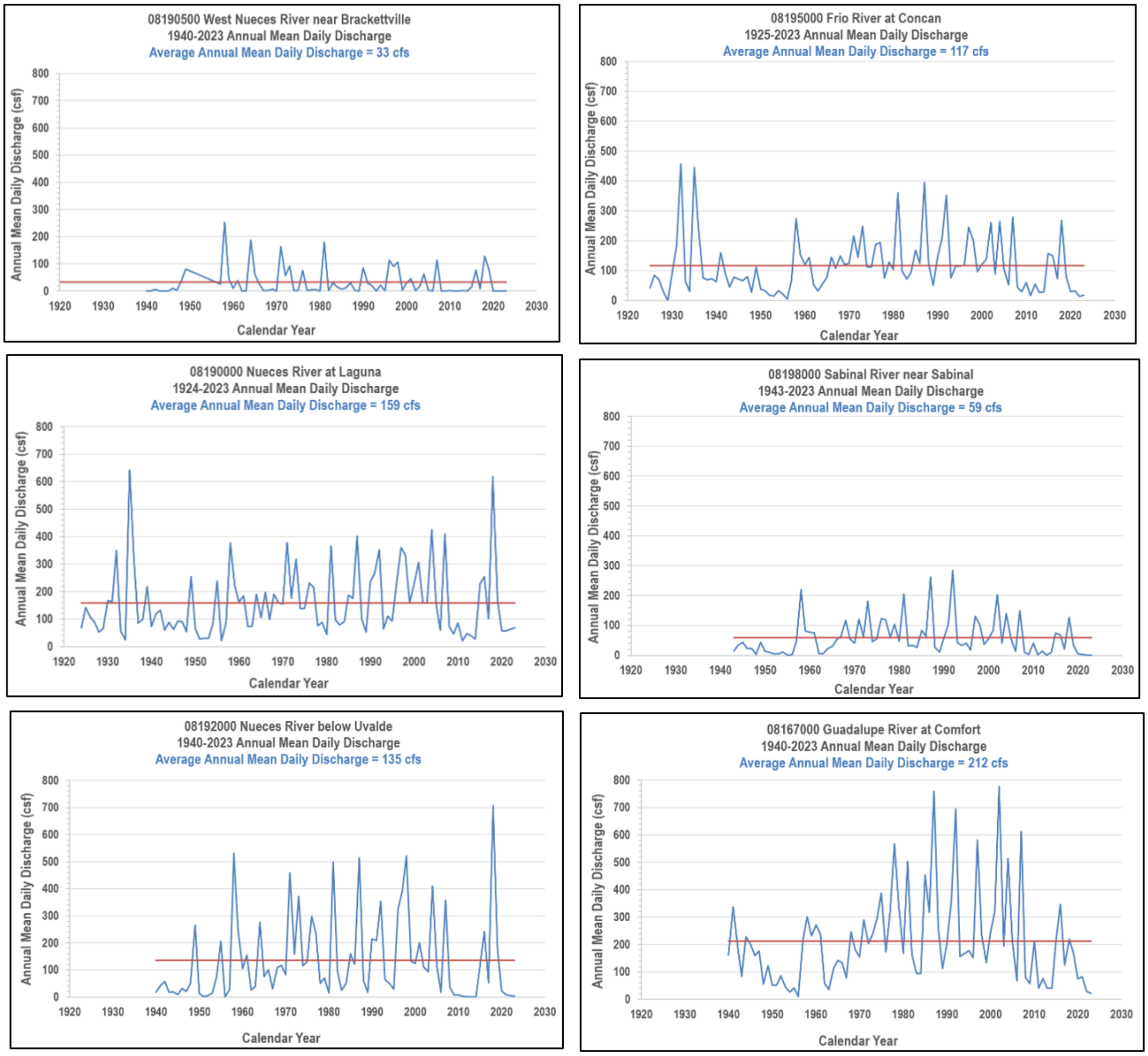

Figure 7-3. Historic Streamflow Gaging Data (1925-2023)
Source: USGS

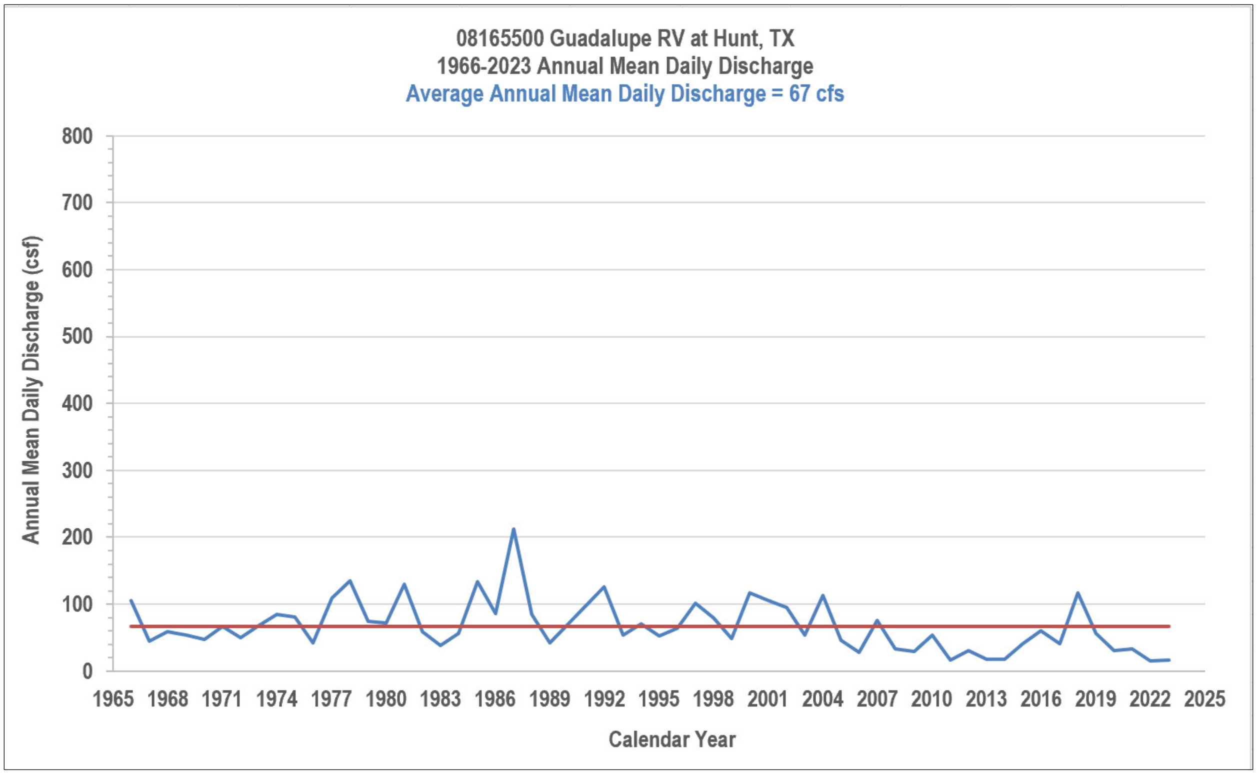

Figure 7-4. Guadalupe River at Hunt Discharge (1965-2023).
Source: USGS

7.1.3 Spring Discharge Indicator

Historic spring flow at USGS station 0846300 – Las Moras Springs at Brackettville, is available for years 1895 through 2023. This data is shown on Figure 7-5. The available data are instantaneous discharge measurements which do not necessarily occur on a regularly scheduled interval. Spring discharge has dropped below five cfs numerous times since 1952 (1953, 1956, 1963, 1964, 1966, 1967, 1969, 1971, 1976, 1978, 1980, 1989, 1995, 1996, 2000, 2006, 2011, 2012, 2014, 2018, 2022, and 2023). The periods with flow less than five cfs typically lasted for up to 3 months. The only exception is a ten-month period between July 2012 and May 2013. A few zero measurements have also occurred (1964, 1967, 1971, 1996, 2022 and 2023). Most of these occurrences appear to have lasted less than six weeks.

San Felipe Springs discharge data were not used because the construction of Lake Amistad in 1968 permanently affected the Spring discharge measurements and therefore comparison between the most recent drought and the DOR would be difficult. According to the USGS webpage, San Felipe Springs (08452800) approved data is undergoing revisions at the monitoring location, making data collection impossible until further notice.

It is uncertain how much of the low flow at Las Moras can be attributed to the anthropological impacts on drought indicators, such as increased groundwater pumping due to drought conditions and increased demands since the 1950s.

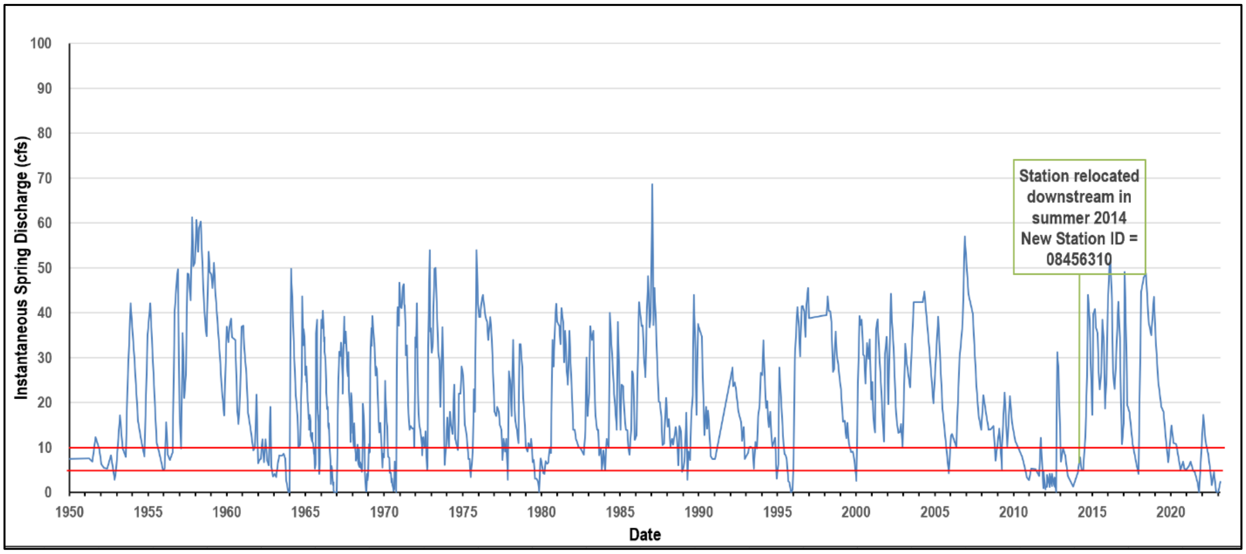

Figure 7-5. Historic Discharge Measurements at Las Moras Springs
Source: U.S. Geological Survey

7.1.4 Groundwater Level Indicator

Figure 7-6 and Figure 7-7 compare daily water level data from existing real-time monitoring wells with daily precipitation data from nearby NWS Cooperative Weather Stations to illustrate aquifer response to precipitation events. Figure 7-6 represents a well in the Edwards-Trinity (Plateau) Aquifer in Val Verde County. The data suggests that response time in the aquifer is quite rapid and occurs within a few days. Note that the water levels in the aquifer remain relatively constant, which suggests that there is not much competition for groundwater near this location. The recent severe drought does not appear to have affected water levels significantly at this location.

Figure 7-7 shows a well completed in the Trinity Aquifer in Real County near Leakey, Texas. The data suggests that response time in the Aquifer is quite rapid and occurs within a few days. Total water level decline in the well is over 100 feet in a span of 18 years. This is likely due to both drought conditions and population growth which both contribute to increased pumping.

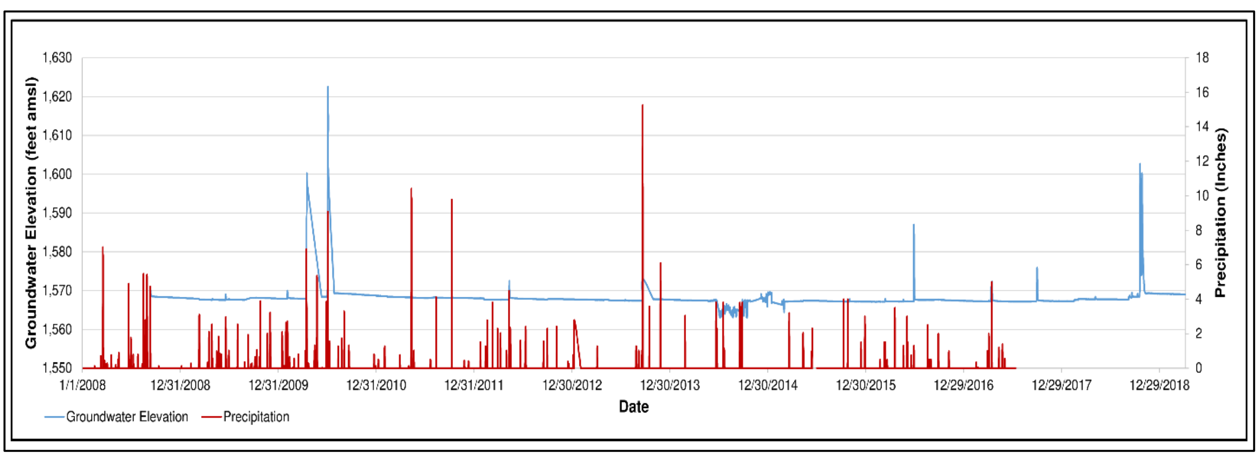

Figure 7-6. Daily Groundwater Elevation and Daily Precipitation, Edwards-Trinity (Plateau), Val Verde County

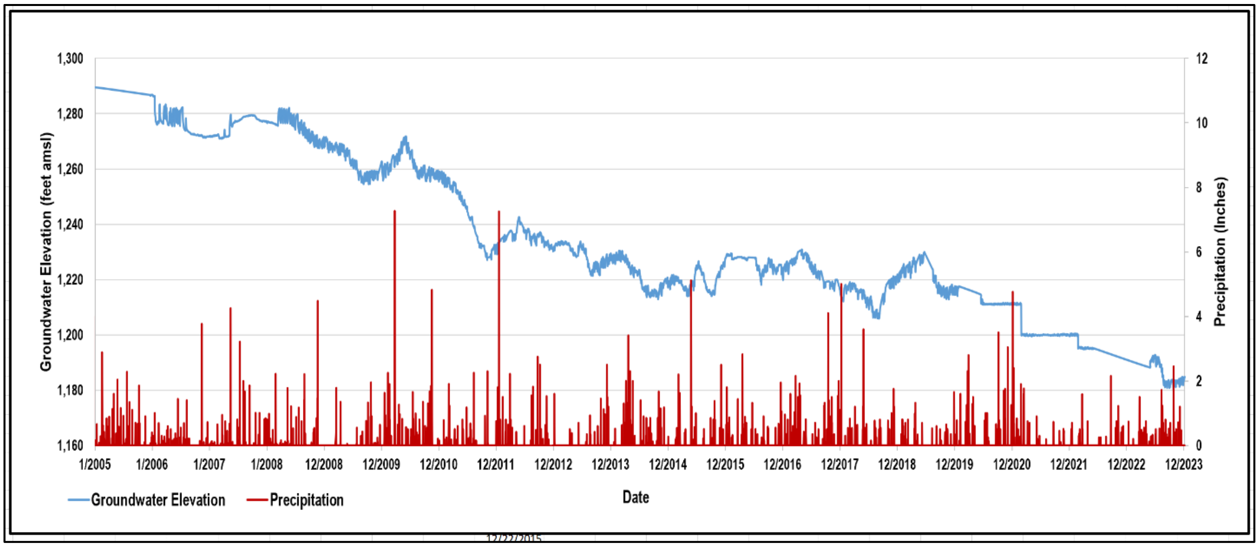

Figure 7-7. Daily Groundwater Elevation and Daily Precipitation, Trinity Aquifer Real County

7.1.5 Plateau Region DOR

For this planning cycle, the drought of the 1950s is declared the DOR.

The catalyst for the recent drought can be attributed primarily to rainfall deficit (meteorological drought). The hydrological drought that has occurred because of rainfall deficit is evident in the decrease in stream flow and spring discharge data that has been presented. However, the greatest unknown factor that these data collectively point to is the impact that can be attributed to anthropological factors.

The hydrological drought (impact on surface waters and groundwater) is a result of both meteorological and socioeconomic drought. To reiterate, socioeconomic drought occurs when physical water needs affect the health, safety, and quality of life of the public or when the drought affects the supply and demand of an economic product. An example of socioeconomic drought is when the demand for an economic product (such as hydroelectric power) exceeds supply due to a weather-related deficit. Typically, demand for a product increases with population growth and per capita consumptions, and supply increases due to efficiency technology and the construction of new water projects. If both are increasing, the rate of change between supply and demand determines the level of socioeconomic drought. However, regardless of the rate of change, when demand exceeds supply, vulnerability is magnified by water shortages during drought.

In future planning cycles, the PWPG encourages studies to quantify how much anthropological factors exacerbate drought severity. Suggested areas of investigation include base flow studies, sub-watershed scale water balance calculations, rainfall deficit quantification, and historical pumping.

7.2 UNCERTAINTY AND DROUGHTS WORSE THAN THE DOR

As mandated by TAC 357.42, the RWPGs must address water supply needs during a repeat of the DOR. During plan development, the generated values of planning factors (supplies, demands, population) all have associated ranges of uncertainty. RWPGs may choose to consider scenarios and/or qualitatively address uncertainty and Drought Worse than the DOR (DWDOR) in their region. This section discusses the scenarios and/or qualitative assessments that can be used to more explicitly recognize the relative planning uncertainties and options to help mitigate those risks.

Texas's strategy of planning for a repeat of the 1950s drought is no longer enough. While historic evidence identifies droughts that were longer and more severe than the DOR, contemporary data points to a likely future of increasing drought severity. A report by Texas 2036 and the Office of the State Climatologist at Texas A&M University projects that rising average temperatures and greater rainfall variability will contribute to a future with more severe droughts. Given this lengthy history and projected future, Texas needs to think differently about how we plan and prepare for drought.

During this current planning cycle, the Drought Preparedness Council (DPC) encourages regional water planning groups to consider planning for drought conditions worse than the DOR, including scenarios that reflect greater rainfall deficits and/or higher surface temperatures. A DWDOR will inflict greater economic damage on industries critical to our continued prosperity.

The Plateau Water Planning Group (PWPG) recognizes that the failure to plan for uncertainties invites economic devastation and therefore they have chosen to evaluate several options to help mitigate risks that may be associated with the DWDOR: (1) use of the Management Supply Factor (MSF), (2) information from water providers that have developed long-range plans that have assessed their system's capacity under conditions worse than the DOR, and (3) demand reductions achieved through the implementation of drought contingency plans (DCPs).

Variability related to population and water demand projections is a major area of concern for the Plateau Region. The planning group made available the draft population and water demand summary tables to municipalities, water providers, county judges, and non-municipal water-use representatives and solicited all entities within the Region to submit desired changes to the projections. Based on the survey responses, draft projections were revised and sent to the TWDB for review. The TWDB approved the submitted revisions requests with the understanding that in the case of Laughlin Airforce Base, the request would be modified to 1,640 held constant throughout the planning horizon. The final population projections for the Region (to include all revisions) are in Chapter 2, Section 2.1.2, and 2.2.

The PWPG considered how to address planning for uncertainty and how such planning could be included for the purposes of the *2026 Plateau Water Plan*. The following items were considered:

- Studies that have been performed that inform upon uncertainties in needs and water availability within the Region, such studies will be noted and considered in the identification of measures taken and their effect. For the purposes of this *Plan*, there are no long-range plans and/or studies available that have been performed to inform upon uncertainties in water needs and water availability within the Region. However, the planning group supports the funding and development of such studies.
- The PWPG recognizes uncertainties both in the projections of population and water demand. As such, WMSs have been developed and recommended that contemplate such uncertainties.
- The *Plan* also identifies potential emergency interconnects that could be useful for informing on decisions of supply availability should DWDOR occur (Section 7.4).

Table 7-1 below lists the water user groups most likely associated with measures that may provide some additional water supply capacity in the event of a near-term DWDOR. The table is divided into two parts: (1) key assumptions, analyses, strategies, and projects that are already incorporated directly into this *Plan*, which provide recommendations that go beyond just meeting identified water needs anticipated during DOR conditions, and (2) potential additional types of measures and responses that are not part of the recommendations in this *Plan*, but that would likely be available to certain water providers/users in the event of the near-term onset of a DWDOR and that would be capable of providing additional, potential capacity for those water providers and user to withstand a DWDOR.

Table 7-1. WUGs/WWPs Most Likely Associated with Measures of Additional Water Supply During Drought Worse than DOR

		Included in the adopted RWP										Measures that may be available beyond the recommended strategies identified in the adopted RWP								
		Built-in conservative modeling or other assumptions					Additional recommendations for additional supplies beyond those needed to meet needs					Demand-management measures				Water supply measures				
WUG/WWP Name	**Applicable water supplies**	**1-year safe yield used in surface water modeling*** **	**Utilizing MAG based upon a DFC developed under drought conditions**	**No return flows**	**Maximum permitted amounts**	**Recharge plus 0.1 volume of water in storage. See report: Occurrence of Significant River Alluvium Aquifers in the Plateau Region (2010)**	**Certain WMSs include 'management supply'**	**Entities that have recommended WMSs that provide water supplies beyond any identified water needs**	**Other**	**Other**	**Other**	**Implement drought management (not a recommended WMS)**	**Other**	**Other**	**Other**	**Implement recommended GW WMSs but earlier than shown in the plan**	**Pursue new direct potable reuse to extend existing supplies**	**Pursue new brackish desalination**	**Other**	**Other**
City of Bandera	Trinity Aquifer		▪					▪				▪				▪		▪		
Bandera County FWSD #1	Trinity Aquifer		▪					▪				▪				▪		▪		
City of Rocksprings	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer		▪					▪				▪				▪		▪		
City of Kerrville	Trinity Aquifer, Guadalupe Run-of-River		▪		▪			▪				▪				▪	▪	▪		
Kerrville South Water	Trinity Aquifer		▪									▪								

Table 7-1. (continued) WUGs/WWPs Most Likely Associated with Measures of Additional Water Supply During Drought Worse than DOR

		Included in the adopted RWP										Measures that may be available beyond the recommended strategies identified in the adopted RWP									
		Built-in conservative modeling or other assumptions					Additional recommendations for additional supplies beyond those needed to meet needs					Demand-management measures				Water supply measures					
WUG/WWP Name	Applicable water supplies	1-year safe yield used in surface water modeling***	Utilizing MAG based upon a DFC developed under drought conditions	No return flows	Maximum permitted amounts	Recharge plus 0.1 volume of water in storage. See report: Occurrence of Significant River Alluvium Aquifers in the Plateau Region (2010)	Certain WMSs include 'management supply'	Entities that have recommended WMSs that provide water supplies beyond any identified water needs	Other	Other	Other	Implement drought management (not a recommended WMS)	Other	Other	Other	Implement recommended GW WMSs but earlier than shown in the plan	Pursue new direct potable reuse to extend existing supplies	Pursue new brackish desalination	Other	Other	
City of Brackettville	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer, Rio Grande Run-of-River		▪		▪			▪				▪						▪			
Fort Clark Springs MUD	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer		▪					▪				▪						▪			
City of Camp Wood	Nueces Run-of-River				▪							▪				▪					

Table 7-1. (continued) WUGs/WWPs Most Likely Associated with Measures of Additional Water Supply During Drought Worse than DOR

		Included in the adopted RWP										Measures that may be available beyond the recommended strategies identified in the adopted RWP								
		Built-in conservative modeling or other assumptions					Additional recommendations for additional supplies beyond those needed to meet needs					Demand-management measures				Water supply measures				
WUG/WWP Name	**Applicable water supplies**	**1-year safe yield used in surface water modeling*** **	**Utilizing MAG based upon a DFC developed under drought conditions**	**No return flows**	**Maximum permitted amounts**	**Recharge plus 0.1 volume of water in storage. See report: Occurrence of Significant River Alluvium Aquifers in the Plateau Region (2010)**	**Certain WMSs include 'management supply'**	**Entities that have recommended WMSs that provide water supplies beyond any identified water needs**	**Other**	**Other**	**Other**	**Implement drought management (not a recommended WMS)**	**Other**	**Other**	**Other**	**Implement recommended GW WMSs but earlier than shown in the plan**	**Pursue new direct potable reuse to extend existing supplies**	**Pursue new brackish desalination**	**Other**	**Other**
City of Leakey	Frio River Alluvium Aquifer					▪		▪				▪				▪				
Del Rio Utilities	Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer, Rio Grande Run-of-River		▪		▪							▪				▪		▪		

7.3 CURRENT DROUGHT PREPARATIONS AND RESPONSE

As mandated by 31 TAC 357.42(a)&(b), this section of the *Plan* summarizes and assesses all preparations and DCPs that have been adopted by municipalities and GCDs within the Plateau Region. The summary includes specific triggers used to determine the onset of each defined drought stage and the associated response actions developed by local entities to decrease water demand during the drought stage.

Because of the range of conditions that affected the more than 4,000 water utilities throughout the State in 1997, the Texas Legislature directed the TCEQ to adopt rules establishing common drought plan requirements for water suppliers. As a result, TCEQ requires all wholesale public water providers, retail public water suppliers serving 3,300 connections or more, and irrigation districts to submit DCP every five years. The deadline for these plans to be submitted to TCEQ was May 1, 2024. In addition, many GCDs also have DCPs that provide education and voluntary action recommendations.

Wholesale water providers and retail public water suppliers serving less than 3,300 connections are required to prepare and adopt updated DCPs. Plans are required to be made available for inspection upon request but are not required to be submitted to the TCEQ. Guidelines as to what should be included in each DCP can be found on TCEQ's website.

DCPs are intended to establish criteria to identify when water supplies may be threatened and the actions that should be taken to ensure these potential threats are minimized. A common feature of DCP is a structure that allows increasingly stringent drought response measures to be implemented in successive stages as water supply decreases and water demand increases. This measured or gradual approach allows for timely and appropriate action as a water shortage develops. The onset and termination of each implementation stage should be defined by specific "triggering" criteria. Triggering criteria are intended to ensure that: 1) timely action is taken in response to a developing situation, and 2) the response is appropriate to the level of severity of the situation. Each water-supply entity is responsible for establishing its own DCP that includes appropriate triggering criteria and responses.

Figure 7-1 illustrates that drought conditions during this current planning period (2021-2025) were more severe than during the previous planning period (2016-2020). As a result, water utilities and conservation districts implemented stringent measures during this recent period. Most entities declared severe or critical stages of drought throughout the warmer/dryer part of 2024. Four public water supply systems were reported by TCEQ to have less than 100-day water supply in August of 2024, within the Region. These systems escalated to an emergency state of drought. Fort Clark Springs MUD is the only system of the four that has recently reverted to a moderate condition. Systems within Bandera County are still experiencing extreme drought conditions. The Bandera County River Authority and Groundwater District as of November of 2024, moved to "extreme" drought restrictions (40 percent reduction in pumping) and continues to monitor water levels within the aquifers.

7.3.1 Drought Response Triggers

Drought response triggers should be specific to each water supplier and should be based on an assessment of the water user's vulnerability. In some cases, it may be more appropriate to establish triggers based on a supply source volumetric indicator such as a lake surface elevation or an aquifer static water level. Similarly, triggers might be based on supply levels remaining in an elevated or ground storage tank within the water distribution system; this is not a recommended approach, as the warning of supply depletion would be only three to four days. Triggers based on demand levels can also be effective, if the demands are very closely and frequently monitored. Whichever method is employed, trigger criteria should be defined on well-established relationships between the benchmark and historical experience. If historical observations have not been made, then common sense must prevail until such time that more specific data can be presented.

7.3.2 Surface Water Triggers

Surface water sources are among the first reliable indicators of the onset of hydrologic drought. Diminished spring discharge and stream flow, for example, can be monitored daily by city, county, and State agencies. Of interest, however, are the levels to which spring discharge and stream flow are reduced before the onset of drought is declared and appropriate response measures are initiated in the Region. Cities that rely exclusively on spring flow for municipal water are particularly vulnerable to drought-induced reductions in discharge, especially if alternative sources of supply have not been developed to make up potential shortfalls created by lower discharge. As an operating definition of hydrologic drought, it is recommended that reductions of spring discharge between 25 percent and 33 percent be considered effective hydrologic drought triggers in the Plateau Region.

7.3.3 Groundwater Triggers

Groundwater triggers that indicate the onset of drought are not as easily identified as factors related to surface-water systems. This is attributable to (1) the rapid response of stream discharge and reservoir storage to short-term changes in climatic conditions within a region and within adjoining areas where surface drainage originates, and (2) the typically slower response of groundwater systems to recharge processes. Although climatic conditions over a period of one or two years might have a significant impact on the availability of surface water, aquifers of the same area might not show comparable levels of response for much longer periods of time, depending on the location and size of recharge areas in a basin, the distribution of precipitation over recharge areas, the amount of recharge, and the extent to which aquifers are developed and exploited by major users of groundwater. However, karstic formations such as the Edwards-Trinity (Plateau) may produce rapid recharge rates in aquifers.

Except for the Trinity Aquifer of Bandera and Kerr Counties, all other aquifers in the rural counties are unlikely to experience significant water-level declines, based on comparisons between projected water demand, aquifer recharge and storage. In these areas, water levels are expected to remain constant or relatively constant over the 50-year planning period (see Figure 7-6). Observation wells in major recharge areas and in areas adjacent to municipal well fields in the rural counties might provide a sufficient number of points to monitor water levels, provided that water-level measurements are made on a regular basis for long periods of time. Water levels below specified elevations for a pre-determined period might be interpreted to be reasonable groundwater indicators of drought conditions in any basin.

Basins that do not receive enough recharge to offset natural discharge and pumpage may be depleted of groundwater (e.g., mined). This is especially the case with the Trinity Aquifer of Bandera and Kerr Counties. The rate and extent of groundwater mining in any area are related to the timeframe and the extent to which withdrawals exceed recharge. In such basins, water levels may fall over long periods of time, eventually reaching a point at which the cost of lifting water to the surface becomes an economical concern. Thus, water levels in such areas may not be a satisfactory drought trigger. Instead, communities might consider the rate at which water levels decline in response to increased demand as a sufficient indicator of drought. Entities that utilize groundwater triggers include Bandera, Rocksprings, Ingram, Loma Vista Water Supply, Brackettville and Fort Clark Springs MUD.

7.3.4 System Capacity Triggers

Because of the above-described problems with using water levels as drought-condition indicators, several municipal water-supply entities in the Plateau Region that rely on groundwater generally establish drought-condition triggers based on levels of demand that exceed a percentage of the systems' production capacity. Rocksprings, Ingram (Aqua Texas), Loma Vista Water System, Camp Wood, City of Del Rio and City of Kerrville utilize drought triggers that consider demand and system capacity components.

7.3.5 Municipal and Wholesale Water Provider DCP

The TCEQ requires all retail public water suppliers serving 3,300 connections or more and wholesale public water providers to submit a drought contingency plan to prepare and respond to water shortages. The amended *Title 30, Texas Administrative Code, Chapter 288* became effective on December 6, 2012 addressing TCEQ's guidelines and plan requirements. The forms for wholesale public water providers, retail public water suppliers and irrigation districts are available on the TCEQ's website.

DCPs for municipal uses by public water suppliers must document coordination with the regional water planning groups to ensure consistency with the regional water plans. The following entities have prepared DCPs:

- City of Bandera.
- City of Kerrville.
- City of Rocksprings.
- City of Camp Wood.
- City of Ingram (Aqua Texas).
- Loma Vista Water System (Aqua Texas).
- City of Brackettville.
- Fort Clark Springs Municipal Water District.
- City of Del Rio (Wholesale Water Provider).

A list of entities, their supply source, specific triggers and actions, for each drought stage is provided in Table 7-2. A DCP was not provided to the Regional Planning Group by Laughlin AFB.

Table 7-2. Municipal Mandated Drought Triggers and Actions

Water Supply Entity	Water Supply Source	Drought Trigger	Drought Stage and Response				
			Mild	Moderate	Severe	Critical	Emergency
City of Bandera	Trinity	Multi-stage drop in water levels in the Dallas Street Municipal Well.	Voluntary conservation May 1 - Sept 30.	Depth to water between 516 and 531 feet.	Depth to water between 532 and 546 feet.	Depth to water between 547 and 566 feet.	Depth to water below 567 feet, or system failure.
			Voluntary usage reduction.	Reduce demand by 20%.	Reduce demand by 30%.	Reduce demand by 40%.	Reduce demand by 50%.
City of Rocksprings	Edwards-Trinity (Plateau)	Based on a comparison of the daily water demand to the static water level of Well #3.	Depth to water reaches 429 feet for 3 consecutive days.	Depth to water reaches 445 feet for 3 consecutive days.	Depth to water reaches 461 feet for 3 consecutive days.	N/A	Depth to water reaches 477 feet for 3 consecutive days.
			Reduce demand by 10%.	Reduce demand by 20%.	Reduce demand by 30%.	N/A	Notify state emergency response officials.
City of Kerrville	Upper Guadalupe River and Trinity Aquifer	Based on a comparison of demand and system's safe operating capacity, which is the maximum amount of water the city can safely deliver to the distribution system. Safe capacity is calculated using the following sources: 1) the WTP, 2) ASR, 3) City wells and 4) other potable sources.	Seven-day average demand exceeds 65% of the system's safe operating capacity.	Seven-day average demand exceeds 75% of the system's safe operating capacity.	Seven-day average demand exceeds 85% of the system's safe operating capacity.	Seven-day average demand exceeds 95% of the system's safe operating capacity.	Seven-day average demand exceeds 100% of the system's safe operating capacity.
			Implement landscape watering schedule; no operation of fountains/ponds.	Landscape watering with hand held hose only; non-essential water use prohibited.	No application for new, additional, or expanded water service connections.	Landscape watering with potable water prohibited.	Allocation of available water; notify state emergency response officials.
City of Ingram (Aqua Texas)	Trinity	Demand-based triggers include the following components: 1) percent of water treatment capacity, 2) total daily demand as percent of pumping capacity, 3) storage capacity (tank level) and 4) well pump run time.	Voluntary conservation late Spring and Summer.	75%, tank level within 4 feet of low-level lockout, 16 hours.	85%, tank level within 3 feet of low-level lockout, 20 hours.	95%, tank level reaches low-level lockout, 22 hours.	
			Reduce demand by 5%.	Reduce demand by 10%.	Reduce demand by 20%.	Reduce demand by 40%.	N/A

Table 7-2. (continued) Municipal Mandated Drought Triggers and Actions

Water Supply Entity	Water Supply Source	Drought Trigger	Drought Stage and Response				
			Mild	Moderate	Severe	Critical	Emergency
City of Ingram (Aqua Texas)	Purchased supply	Supply-based triggers are utilized for systems Aqua provides water from either a district, authority or wholesale supplier.	Upon notification by district, authority, or wholesale supplier, Aqua may implement equivalent stage and restrictions.				
City of Brackettville	Edwards-Trinity (Plateau)	Multi-stage drops in water levels in city well.	Depth to water reaches 50 feet or less while pumping (based on 10-day moving average).	Depth to water reaches 65 feet or less while pumping (based on 10-day moving average).	Depth to water reaches 85 feet or less while pumping (based on 10-day moving average).	Depth to water reaches 110 feet or less while pumping (based on 10-day moving average).	
			Reduce demand by 10%.	Reduce demand by 15%.	Reduce demand by 25%.	N/A	Notify state emergency response officials.
Fort Clark Springs Municipal Water District	Edwards-Trinity (Plateau)	Multi-stage drops in water levels in municipal well.	Depth to water reaches 25 feet or more from ground level while pumping (based on 10-day moving average).	Depth to water reaches 35 feet or more from ground level while pumping (based on 10-day moving average).	Depth to water reaches 50 feet or more from ground level while pumping (based on 10-day moving average).	Depth to water reaches 75 feet or more from ground level while pumping (based on 10-day moving average).	Fort Clark MUD will recognize an emergency exists based on the “critical” stage criteria.
			Voluntary - reduce demand by 10%.	Reduce demand by 15%.	Reduce demand by 25%.	N/A	Notify state emergency response officials.
City of Camp Wood	Spring flow from Edwards-Trinity (Plateau)	Base on system capacity limits.	Low distribution pressure for more than 6 hours.	Demand exceeds 70% of safe operating capacity (based on seven-day average).	Demand exceeds 80% of safe operating capacity (based on seven-day average).	Demand exceeds 90% of safe operating capacity (based on seven-day average).	Major system failures or supply contamination.
			Voluntary - reduce demand by 6%.	Reduce demand by 6%.	Reduce demand by 11%.	Reduce demand by 20%.	Reduce demand by 30%.

Table 7-2. (continued) Municipal Mandated Drought Triggers and Actions

Water Supply Entity	Water Supply Source	Drought Trigger	Drought Stage and Response				
			Mild	Moderate	Severe	Critical	Emergency
City of Del Rio	San Felipe Springs Edwards-Trinity (Plateau)	Water levels in Bedell Street Storage Reservoirs are less than a designated depth; San Felipe Spring flow drops below a specific flow rate.	Water levels are less than 30 feet; San Felipe Spring flow is less than 40 mgd.	Water levels are less than 25 feet; San Felipe Spring flow is less than 30 mgd.	Water levels are less than 20 feet; San Felipe Spring flow is less than 25 mgd.	Water levels are less than 15 feet; San Felipe Spring flow is less than 20 mgd.	N/A
			Reduce demand to 95% of the 30-day average prior to initiation.	Reduce demand to 90% of the 30-day average prior to initiation.	Reduce demand to 80% of the 30-day average prior to initiation.	Critical (Stage 4) is characterized by an emergency situation. Notify state emergency response officials.	Notify state emergency response officials.
Loma Vista Water Supply (Aqua Texas)	Trinity	Demand-based triggers include the following components: 1) percent of water treatment capacity, 2) total daily demand as percent of pumping capacity, 3) storage capacity (tank level) and 4) well pump run time.	Voluntary conservation late Spring and Summer.	75%, tank level within 4 feet of low-level lockout, 16 hours.	85%, tank level within 3 feet of low-level lockout, 20 hours.	95%, tank level reaches low-level lockout, 22 hours.	
			Reduce demand by 5%.	Reduce demand by 10%.	Reduce demand by 20%.	Reduce demand by 40%.	N/A
	Purchased supply	Supply-based triggers are utilized for systems Aqua provides water from either a district, authority or wholesale supplier.	Upon notification by district, authority, or wholesale supplier, Aqua may implement equivalent stage and restrictions.				

7.3.6 Groundwater Conservation District DCPs

A discussion of the creation and the goals of the four GCDs formed in the Plateau Region are discussed in more detail in Chapter 5, Section 5.3.7. This section will focus on summarizing drought management by the Districts.

Four districts are currently in operation within the planning region:

- Bandera County River Authority and Groundwater District.
- Headwaters Groundwater Conservation District.
- Kinney County Groundwater Conservation District.
- Real-Edwards Conservation and Reclamation District.

Groundwater Conservation Districts are required to define management goals that specifically address drought conditions within their groundwater management plans. These are delineated via management objectives and performance standards. DCPs have also been adopted by three of the four GCDs in the Plateau Region. The following are the four District's drought management objectives.

7.3.6.1 Bandera County River Authority and Groundwater District

Management Objective 1 – Record the PDSI each month, post the drought stage and any appropriate drought restrictions outlined in the Drought Management Plan as adopted in October 2013.

Management Objective 2 – Evaluate groundwater availability each year by monitoring water levels of the aquifer from monitor wells within Bandera County.

The District has implemented a drought management plan to aid in groundwater conservation and is designed to reduce pumpage of the aquifer during the different drought stages. The triggers and actions incorporated into the drought plan are summarized below. These five drought stages are mandated restrictions for permitted wells and recommended restrictions for exempt wells.

Bandera County River Authority and Groundwater District
Drought Triggers and Actions

Stage & Description	1 – Mild	2 – Moderate	3 – Severe	4 – Extreme	5 - Exceptional
Trigger	Stages are triggered by the U.S. Drought Monitor but can be adjusted at the discretion of the District when aquifer levels, rainfall and river flow conditions warrant.				
Conservation Goal (percent reduction in pumpage)	10%	20%	30%	40%	50%

7.3.6.2 Headwaters Groundwater Conservation District

Management Objective 1 – Monitor drought conditions by reviewing aquifer data monthly and declaring drought stages based on the District's defined drought triggers.

Management Objective 2 – The District will monitor and consider the Lower Trinity drought index wells (HGCD Monitor Well No. 2, HGCD Monitor Well No. 18, COK Mack Holliman, and Aqua Texas Kelly Street, Center Point).

Management Objective 3 – The District will also monitor and consider the PDSI and the Guadalupe River Flow Rate at Kerrville in initiating drought stages.

The District has implemented a drought management plan to aid in groundwater conservation and is designed to reduce pumpage of the aquifer during the different drought stages. The triggers and actions incorporated into the drought plan are summarized below.

Headwaters Groundwater Conservation District Drought Triggers and Actions

Stage & Description	1 – Mild	2 – Moderate	3 – Severe	4 – Extreme
Trigger	1,420 feet amsl	1,410 feet amsl	1,400 feet amsl	1,390 feet amsl
Conservation Goal (percent reduction in pumpage)	10%	20%	30%	40%

The HGCD Drought Index Levels which are the average water level in four selected monitor wells (HGCD MW No. 5 Middle Trinity, HGCD MW No. 7 Middle Trinity, HGCD MW No. 11 Middle Trinity, and County Agriculture Barn). Drought stages may be initiated at the discretion of the District depending on the ability of the City of Kerrville to draw surface water from the Guadalupe River.

These four drought stages invoke mandated restrictions for permitted wells and recommended restrictions for exempt wells.

7.3.6.3 Kinney County Groundwater Conservation District

Management Objective – Once a month, the District will download the latest drought information from the National Weather Service – Climate Prediction Center website. A report on the drought data obtained from the National Weather Service will be included in the regular monthly meeting agenda and retained in the meeting minutes kept at the District office.

7.3.6.4 Real-Edwards Conservation and Reclamation District

Management Objective – Curtailment of Groundwater Withdrawal. To accomplish this objective, the annual amount of groundwater permitted by the District for withdrawal from the portion of the aquifers located within the District may be curtailed during periods of extreme drought in the recharge zones of the aquifers or because of other conditions that cause significant declines in groundwater surface elevations. Such curtailment may be triggered by the District's Board of Directors based on the groundwater elevation measured in the District's monitoring well(s) and/or stream flow measurements along with other indices such as rainfall and soil moisture. District staff currently monitors three locations along the Frio River and its tributaries and two locations on the Nueces River. A weir box will be placed on Old Faithful Spring and measurements will be routinely taken at that location. The triggers and actions incorporated into the drought plan are summarized below.

Real-Edwards Conservation and Reclamation District Drought Triggers and Actions

Stage & Description	1 – Mild	2 – Moderate	3 – Severe	4 – Extreme
Trigger	PDSI -1 or less	PDSI -2 or less	PDSI -3 or less	PDSI -4 or less
Conservation Goal (percent reduction in pumpage)	Voluntary	10%	20%	30%

The PDSI, which is an index based on regional meteorological and hydrological data such as rainfall, temperature and soil moisture content will be used as the primary triggering criteria for the initiation and termination of the drought plan.

The four drought stages are mandated restrictions for permitted wells during stages 2, 3, and 4 and recommended restrictions for exempt wells.

7.3.7 Description of Current Preparations for Drought in the Region Including Unnecessary or Counterproductive Drought Response

The following discussion is new to the sixth cycle of regional water planning, as it was added late during the fifth cycle by House Bill 807. Within this new subsection, the Region must consolidate and present: (1) a description of how water suppliers in the Region identify and respond to drought conditions (this may include information from local DCP), and (2) a summary of drought response efforts that the Region has identified as unnecessary or counterproductive.

Table 7-2 is a list of entities, their supply source, specific triggers and actions, for each drought stage found within a total of 10 collected DCP within the Region. These plans are also accessible at their specified websites. In addition, Section 7.3.6 summarizes drought management by the four GCDs formed within the Plateau Region. The information provided within Table 7-2 and Section 7.3.6 informs upon how water suppliers within the Region identify and respond to drought conditions.

The Plateau Region is comprised mainly of rural communities, where neighboring communities are miles apart, if not often in separate counties. Due to the distance between communities within the Region, the planning group has not identified any unnecessary or counterproductive drought responses. The PWPG does not feel that any of the DCPs within the Region cause public confusion or impede any drought response efforts at this time.

7.4 EXISTING AND POTENTIAL EMERGENCY INTERCONNECTS

According to Texas Statute §357.42(d), (e) regional water planning groups are to collect information on existing major water infrastructure facilities that may be used in the event of an emergency shortage of water. Pertinent information includes identifying the potential user(s) of the interconnect, the potential supplier(s), the estimated potential volume of supply that could be provided, and a general description of the facility. Texas Water Code §16.053(c) requires information regarding facility locations to remain confidential. This section provides general information regarding existing and potential emergency interconnects among water user groups within the Plateau Region.

The RWPG is required to gather information pertinent to major water infrastructure facilities that are currently or could potentially be utilized during emergency water shortages. Major water infrastructure facilities within the Plateau Region were identified through a survey process to better evaluate existing and potentially feasible emergency interconnects. There are no existing emergency interconnects. There are only three potential interconnects that have been identified within the Plateau Region in the current planning cycle, as shown below. Regarding the City of Leakey, the City has acquired a well that was once privately owned. This well is not currently being used by the City but would be added to the City's supply in a state of emergency.

Potential Emergency Interconnects to Major Water Facilities

Entity Providing Supply	Entity Receiving Supply
City of Kerrville	Cherokee Mobile Home Park
City of Del Rio	Laughlin AFB and the Landings at Laughlin
City of Leakey	City of Leakey

7.5 EMERGENCY RESPONSES TO LOCAL DROUGHT CONDITIONS OR LOSS OF MUNICIPAL SUPPLY

Texas Statute §357.42(d) requires regional water planning groups to evaluate potential temporary emergency water supplies for all county-other WUGs and municipalities that have 2030 projected populations less than 7,500 that rely on a sole source of water. The purpose of this evaluation is to identify potential alternative water sources that may be considered for temporary emergency use in the event that the existing water-supply sources become temporarily unavailable due to extreme hydrologic conditions such as emergency water right curtailment, unanticipated loss of reservoir conservation storage, or other localized drought impacts.

This section provides potential solutions that should act as a guide for municipal water users that are most vulnerable in the event of a loss of supply. Entities evaluated for emergency responses to local drought conditions or loss of municipal supply were assumed to have 180 days or less of remaining supply. This review was limited and did not require technical analyses or evaluations following in accordance with 31 TAC §357.34.

In the Plateau Region, there are 22 municipal and county-other WUGs that have a 2030 projected population of less than 7,500. Of those 22 WUGs, seven entities rely upon a sole source of water. Six of the sole source WUGs rely on groundwater, and one WUG relies on surface water (City of Camp Wood).

Potential emergency water-supply sources that might be used by small sole-source municipal WUGs or county-other WUGs include the following:

- New local groundwater well.
- Emergency interconnect.
- Use of other named local supply.
- Trucked-in water delivery.
- Brackish groundwater limited treatment.
- Brackish groundwater desalination.
- Release from upstream reservoir.
- Curtailment of upstream and/or downstream water rights.

Based upon personal communication with the WUGs within the Plateau Region, the addition of a new local groundwater well was identified for all entities as a potential emergency water supply source. The Bandera County FWSD No. 1 (Bandera county-other) would also consider the curtailment of proximal water rights, and the City of Bandera would also consider trucked-in water delivery as a feasible option under emergency conditions. The entities along with feasible potential emergency water supply options have been included in Table 7-3.

Table 7-3. Emergency Responses to Local Drought Conditions

Entity						Implementation Requirements									
Water User Group Name	**County**	**2024 Population Served by Water System (per TCEQ)**	**2024 Service Connections (per TCEQ)**	**2030 Projected Population**	**2030 Projected Water Demand (AF/year)**	**Drill additional groundwater wells**	**Brackish groundwater limited treatment**	**Brackish groundwater desalination**	**Emergency interconnect**	**Other named local supply**	**Trucked-in water**	**Type of infrastructure required**	**Entity providing supply**	**Other local entities required to participate/ coordinate**	**Emergency agreements/ arrangements already in place?**
City of Bandera	Bandera	3,066	1,070	1,949	347	▪			▪		▪	Well	City	N/A	N/A
Bandera County FWSD #1	Bandera	1,092	438	1,074	342	▪			▪		▪	Well	District	N/A	N/A
City of Rocksprings	Edwards	1,857	574	666	175	▪			▪		▪	Well	City	N/A	N/A
City of Kerrville	Kerr	22,519	10,297	33,038	7,839	▪					▪	Well	City	N/A	N/A
Kerrville South Water	Kerr	No Data		3,600	457	▪	▪				▪	▪	Aqua Tas	N/A	N/A
City of Brackettville	Kinney	2,570	831	1,077	528	▪					▪	Well		N/A	N/A
Fort Clark Springs MUD	Kinney	1,200	989	1,372	727	▪					▪	Well		N/A	N/A
City of Camp Wood	Real	1,380	460	339	147	▪			▪		▪	Well	City	N/A	N/A
City of Leakey	Real	1,758	586	210	143	▪			▪		▪	Well	City	N/A	N/A
Laughlin Air Force Base	Val Verde	4,010	497	1,640	969	▪			▪		▪	Well	City of Del Rio	N/A	N/A
County-Other															
Bandera River Ranch 1	Bandera	1,038	346	Data Not Provided		▪			▪		▪	Well	W	N/A	N/A
Medina WSC	Bandera	774	258			▪					▪	Well		N/A	N/A
Flying L Ranch PUD	Bandera	987	329			▪					▪	Well		N/A	N/A
Barksdale WSC	Edwards	279	93			▪					▪	Well		N/A	N/A
Center Point North WS	Kerr	270	90			▪			▪		▪	Well		N/A	N/A
Center Point Taylor System	Kerr	531	177			▪			▪		▪	Well	Distrt	N/A	N/A
Cedar Springs MHP	Kerr	144	48			▪			▪		▪	Piping	Ingram Oks Park	N/A	N/A
Heritage Park WS	Kerr	87	29			▪			▪		▪	Piping	Aqua Tas	N/A	N/A
Oak Ridge Estates WS	Kerr	123	41			▪					▪	Well		N/A	N/A
Verde Park Estates	Kerr	213	71			▪			▪		▪	Piping	Elmwoo MHP	N/A	N/A
Vista Hills	Kerr	48	16			▪					▪	Well		N/A	N/A
Westwood WS	Kerr	339	113			▪			▪		▪	Well		N/A	N/A
Windwood Oaks WS	Kerr	60	20			▪			▪		▪	Piping	The W Sub.	N/A	N/A

To qualify for emergency funds that are earmarked for emergency groundwater supply wells, entities must have a drought plan in place and be currently listed as an entity that is limiting water use to avoid shortages. This list is updated weekly by the TCEQ's Drinking Water Technical Review and Oversight Team and can be found on the TCEQ's website.

There is some assistance available through the Texas Department of Agriculture and the Texas Water Development Board. There are requirements, deadlines, and a specific application process. Contact the TWDB by e-mail at Financial_Assistance@twdb.texas.gov, or call 512-463-7853. Contact the Texas Department of Agriculture, Community Development Block Grants, or call 512-936-7891. Funding is limited.

TCEQ offers a variety of resources pertaining to drought, current priority calls, current drought conditions, water conservation and more. Those TCEQ Guidance resources are located on their website.

7.6 REGION-SPECIFIC MODEL DROUGHT RESPONSE RECOMMENDATIONS AND MODEL CONTINGENCY PLANS

As mandated by TAC 357.42(c)&(i), the RWPGs shall develop drought response recommendations regarding the management of existing groundwater and surface water sources in the RWPA designated in accordance with §357.32. The RWPGs shall make drought preparation and response recommendations regarding the development of content contained within, and implementation of local DCPs. The RWPGs shall develop region-specific model DCPs that shall be presented in the RWP which shall be consistent with 30 TAC Chapter 288 requirements.

Regional drought planning expands the conceptualization and application of drought planning by specific entities to encompass the entire Plateau Region. The approach utilized in developing a region-specific drought plan will consider the following: (1) all regional groundwater and surface water sources, (2) current drought plans that are being utilized by user entities within the Region, and (3) current monitoring stations within the Region that have evolved since the previous planning cycle.

The goals of this approach are: (1) to gain a comprehensive view of what particular resources are being monitored by entities within the Region, (2) determine which resources are not being monitored, (3) determine which users do not fall under the umbrella of existing DCPs, (4) identify potential monitoring stations with publicly accessible real-time data that currently exist, and (5) determine how these data can be utilized for the water-user groups that do are not subject to existing DCPs, and ultimately (6) development of a regional model drought contingency plan.

As discussed in Section 7.3, several GCDs, towns/cities and various public supply systems have written drought management / contingency plans and have provided them for inclusion in this *Plan.*

7.6.1 Regional Groundwater Resources and Monitoring

The six groundwater resources identified within the Plateau Region and their contribution to total regional groundwater supply are:

- Austin Chalk (2 percent).
- Edwards (BFZ) (4 percent).
- Edwards-Trinity (Plateau) (2 percent).
- Edwards-Trinity (Plateau), Pecos Valley & Trinity (76 percent).
- Ellenburger-San Saba (1 percent).
- Frio River Alluvium (1 percent).
- Nueces River Alluvium (2 percent).
- Trinity (13 percent).

The aquifer contribution to the regional supply calculation is based upon Table 3-1. Water Source Availability. This data is provided by the TWDB for regional planning purposes.

Current DCPs were detailed in Section 7.3.5 and Table 7-2. State well numbers of the monitoring wells used by municipal entities that utilize groundwater triggers are shown in Table 7-4. A map of these locations is included as Figure 7-8.

Table 7-4. Current Municipal Trigger Monitoring Wells

Water Supply Entity	County	Water Supply Source	Well ID
City of Rocksprings	Edwards	Edwards-Trinity (Plateau)	55-63-803 Sharp Well
City of Bandera	Bandera	Trinity	69-24-102 Dallas Street Well
Fort Clark Springs MUD	Kinney	Edwards-Trinity (Plateau)	70-45-504 Well #1
City of Brackettville	Kinney	Edwards-Trinity (Plateau)	70-45-601 Well #1

Previous Plateau Regional Water Plans identified wells that could potentially be used for drought monitoring. Table 7-5 provides a selection of groundwater trigger wells included in the 2011, 2016 and 2021 Plans, with an updated status and period of record.

Table 7-5. RWP Groundwater Trigger Monitoring Wells

Aquifer	County	Well ID	Monitoring Agency	Period of Record	Current Status
Trinity	Bandera	69-16-902 (Purple Sage Well)	Unknown	Unknown	Inactive -
Edwards-Trinity (Plateau)	Edwards	55-63-803 (City of Rocksprings)	TWDB	1953-2022	Active
Trinity	Kerr	56-63-916	HGCD (Donna Drive Well)	1977-2019	Currently active in HGCD network
Edwards-Trinity (Plateau)	Kerr	56-53-304	Not being monitored	1966-1998	Inactive - Replaced by HGCD network
Edwards-Trinity (Plateau)	Kinney	Ring Well	Unknown	Unknown	Unknown
Edwards (BFZ)	Kinney	70-38-902	TWDB	1973-2020	Active
Austin Chalk	Kinney	70-45-404	TWDB	1937-2009	Unknown
Frio River Alluvium	Real	69-18-302 (City of Leakey)	Unknown	Unknown	Unknown
Edwards-Trinity (Plateau)	Val Verde	Old Y Well	City of Del Rio	2013-2014	Inactive
Edwards-Trinity (Plateau)	Val Verde	Agarita Well	City of Del Rio	Unknown	Inactive
Edwards-Trinity (Plateau)	Val Verde	Tiera del Largo Well	City of Del Rio	Unknown	Inactive

The TWDB has a component of their website called Water Data for Texas (like the USGS's NWIS server) that is a collective of real-time monitoring data from both groundwater wells and reservoir stage-capacity gages. Table 7-6 is a summary of the 30 groundwater wells located within the Plateau Region. These locations are included on Figure 7-8.

Table 7-6. Currently Active (Real-Time) Monitoring Wells
Source: Water Data for Texas

County	State Well ID	Aquifer	Aquifer Type	Entity/Cooperator	Data Transmission	Latest Transmission Date as of 9/2024
Bandera	6912206	Edwards-Trinity Plateau	Unconfined	U.S. Geological Survey 1	Satellite	9/18/2024
Bandera	6923402	Trinity	Confined	U.S. Geological Survey 1	Satellite	8/5/2024
Bandera	6924225	Trinity	Confined	Texas Water Development Board	Satellite	9/17/2024
Edwards	5545902	Edwards-Trinity Plateau	Unconfined	Texas Water Development Board	Satellite	9/17/2024
Edwards	7013906	Edwards-Trinity Plateau	Unconfined	Texas Water Development Board	Satellite	9/17/2024
Kerr	5644901	Trinity	Confined	Headwaters GCD	Satellite	9/17/2024
Kerr	5654405	Trinity	Confined	Texas Water Development Board	Satellite	9/18/2024
Kerr	5659201	Trinity	Confined	Headwaters GCD	Satellite	9/17/2024
Kerr	5663923	Trinity	Confined	Headwaters GCD	Satellite	9/18/2024
Kerr	5663924	Trinity	Confined	Headwaters GCD	Satellite	9/18/2024
Kerr	6801703	Trinity	Confined	Headwaters GCD	Satellite	9/17/2024
Kerr	6801704	Trinity	Confined	Headwaters GCD	Satellite	9/17/2024
Kerr	6904503	Trinity	Confined	Headwaters GCD	Satellite	5/12/2024
Kerr	6907107	Trinity	Confined	Headwaters GCD	E-Line	11/26/2024
Kerr	5757805	Trinity	Confined	Headwaters GCD	E-Line	11/26/2024
Kerr	5661101	Trinity	Confined	Headwaters GCD	E-Line	11/27/2024
Kerr	5655805	Trinity	Confined	Headwaters GCD	E-Line	11/26/2024
Kerr	6908304	Trinity	Confined	Headwaters GCD	E-Line	11/27/2024
Kerr	6908305	Trinity	Confined	Headwaters GCD	E-Line	11/27/2024
Kerr	5643901	Trinity	Confined	Headwaters GCD	E-Line	11/25/2024
Kerr	5652704	Trinity	Confined	Headwaters GCD	Sonic-Dp	11/25/2024
Kerr	5654106	Trinity	Confined	Headwaters GCD	Sonic-Dp	11/25/2024
Kerr	5664301	Trinity	Confined	Headwaters GCD	E-Line	11/26/2024
Kerr	5661907	Trinity	Confined	Headwaters GCD	E-Line	11/25/2024
Kerr	5749802	Ellenburger	Confined	Headwaters GCD	E-Line	11/26/2024
Kerr	6907305	Trinity	Confined	Headwaters GCD	E-Line	11/26/2024
Kinney	7038902	Edwards (Balcones Fault Zone)	Unconfined	Texas Water Development Board	Satellite	9/17/2024
Real	6919401	Trinity	Confined	Texas Water Development Board	Satellite	9/17/2024
Val Verde	5463401	Edwards-Trinity Plateau	Unconfined	Texas Water Development Board	Satellite	9/17/2024
Val Verde	7001707	Edwards-Trinity Plateau	Unconfined	Texas Water Development Board	Satellite	9/17/2024

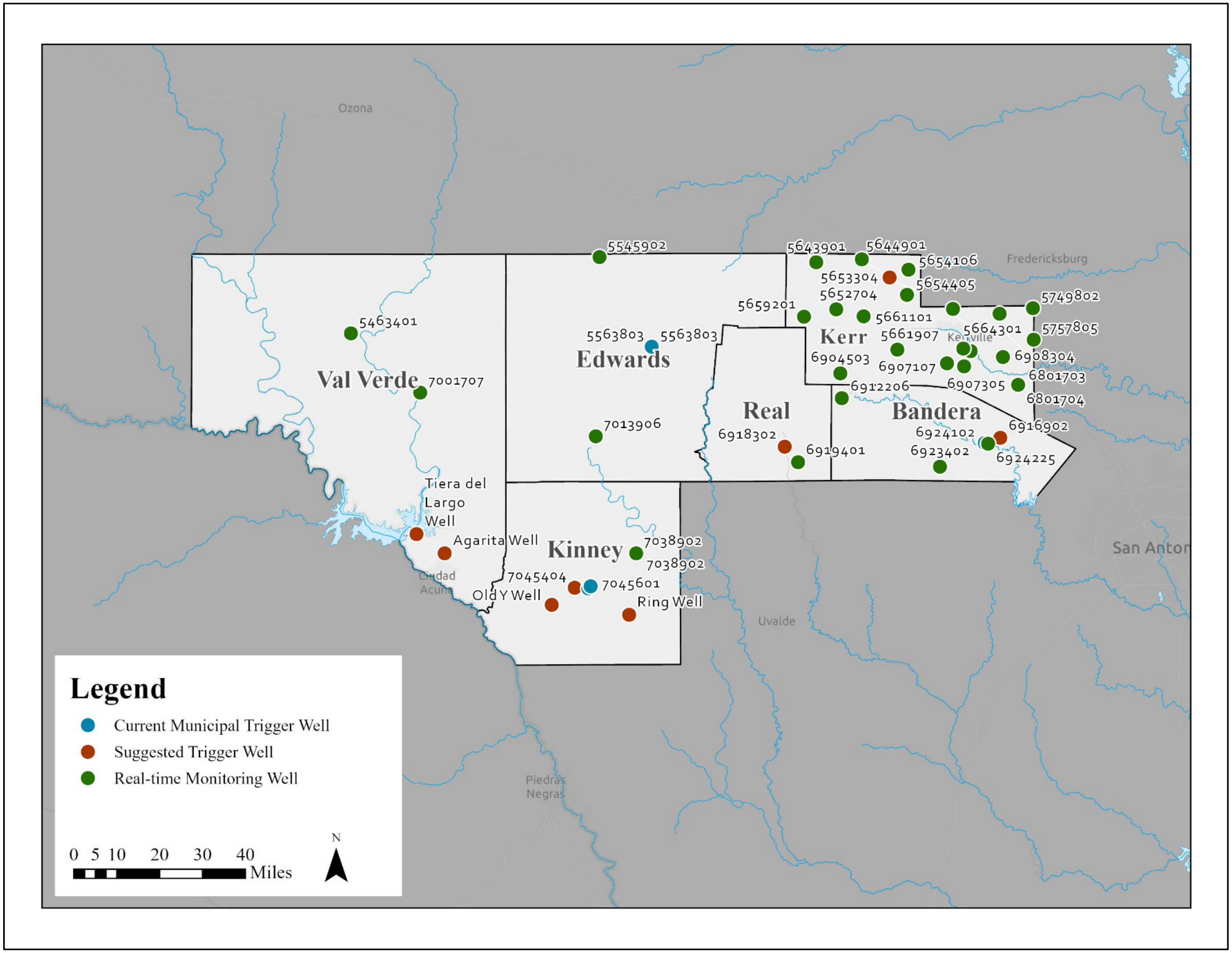

Figure 7-8. Regional Monitoring and Trigger Wells

7.6.2 Regional Surface Water Resources and Monitoring

The five surface water basins identified within the Plateau Region and their contribution to total regional surface water supply are:

- Colorado River Basin (<1 percent).
- Rio Grande Basin (79 percent).
- Nueces River Basin (10 percent).
- Guadalupe River Basin (10 percent).
- San Antonio River Basin (<1 percent).

The basin contribution to the regional supply calculation is based upon the WAM Run 3 (Full Authorization) availability numbers. Surface water features that are actively being monitored by an entity within the Plateau Region are detailed in Table 7-7.

Table 7-7. Surface Water Sources Currently Monitored by Regional Entities
Source: Plateau Region DCP

Entity	County	Water Supply Source	Station ID	Measuring Agency	Period of Record	Current Measurement Frequency
City of Del Rio	Val Verde	San Felipe Springs	08-4530.00 (gage on creek)	IBWC	1931-2024	15 minutes
Headwaters GCD	Kerr	Guadalupe River	08166200 Guadalupe River at Kerrville	USGS	1986 -2024	15 minutes
Real-Edwards CRD	Real	Frio River	Fulgham's crossing, Leakey Springs crossing, Mill Creek crossing, Frio River Place crossing	RECRD	Unknown	Monthly
Real-Edwards CRD	Real	Frio River - West Prong	Rancho Real crossing, Kent Creek crossing	RECRD	Unknown	Monthly
Real-Edwards CRD	Edwards	Nueces River	McDonald's Crossing, Nueces River Dam	RECRD	Unknown	Monthly
Real-Edwards CRD	Edwards	South Llano River	Telegraph crossing, Hwy 377 at Evergreen School crossing	RECRD	Unknown	Monthly

The only station that is utilized as an active trigger is San Felipe Springs. The other stations are included in this table to present a complete list of surface water locations that are currently being monitored within the Region. Note that the Guadalupe River is an optional trigger for HGCD. The Frio and Nueces crossings that are measured by the RECRD are posted on their website monthly.

A list of all currently active stream flow, spring flow and reservoir stage gaging stations are listed in Table 7-8. The USGS stations have real-time data that is publicly accessible online. These locations are shown on Figure 7-9.

Table 7-8. Currently Active Surface Water Gaging Locations
Source: Water Data for Texas

County	Station ID	Station Name	Agency
Rio Grande Basin			
Val Verde	8449100	Dolan Creek abv Devils River near Comstock, TX	USGS
Val Verde	8447410	Pecos River near Langtry, TX	USGS
Val Verde	08-3772.00	Rio Grande at Foster Ranch near Langtry, TX	IBWC
Val Verde	08-4508.00	International Amistad Reservoir Storage	IBWC
Val Verde	08-4530.00	San Felipe Creek	IBWC
Kinney	8456300 and 8456310	Las Moras Springs at Brackettville, TX (main channel)	USGS
Nueces River Basin			
Kinney	8190500	W Nueces River near Brackettville, TX	USGS
Edwards	818999010	Nueces River near Barksdale, TX	USGS
Real	8194840	Frio River at Leakey, TX	USGS
Bandera	8197936	Sabinal River below Mill Creek near Vanderpool, TX	USGS
Guadalupe River Basin			
Kerr	8165300	North Fork Guadalupe River near Hunt, TX	USGS
Kerr	8165500	Guadalupe River at Hunt, TX	USGS
Kerr	8166000	Johnson Creek near Ingram, TX	USGS
Kerr	8166140	Guadalupe River above Bear Creek at Kerrville, TX	USGS
Kerr	8166200	Guadalupe River at Kerrville, TX	USGS
Kerr	8166250	Guadalupe River near Center Point, TX	USGS
San Antonio River Basin			
Bandera	817887350	Medina River at Patterson Road at Medina, TX	USGS
Bandera	8178880	Medina River at Bandera, TX	USGS
Bandera	8178980	Medina River above English Creek Spring near Pipe Creek, TX	USGS
Medina	8179500	Medina Lake near San Antonio, TX	USGS

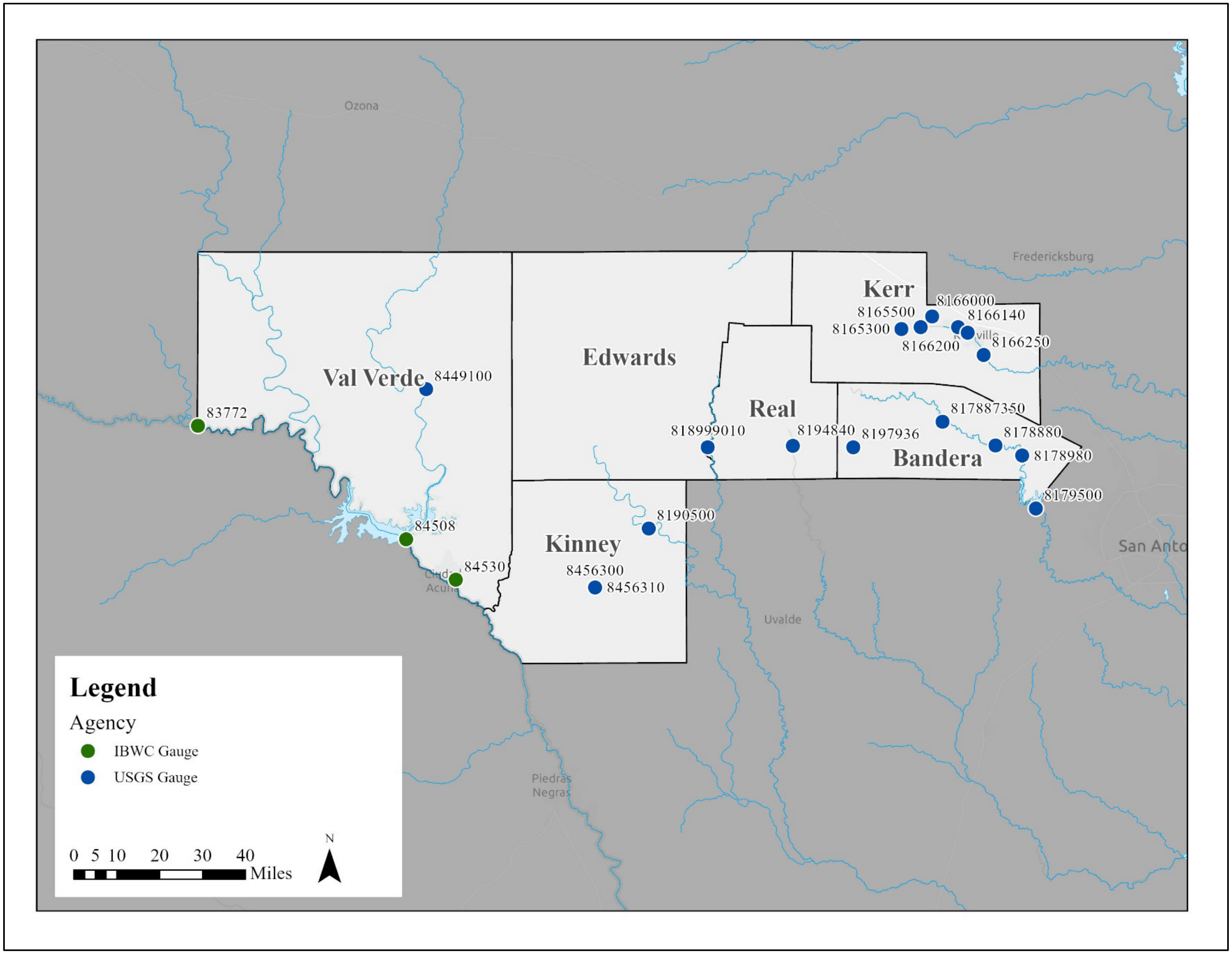

Figure 7-9. Currently Active Surface Water Gaging Locations

7.6.3 Regional Model Drought Contingency Plan

The Regional Model DCP summary table (Table 7-9) provides an overview of all existing regional water sources, WUGs, monitoring wells, and gaging stations as well as recommended drought triggers and actions. The intent of including the monitoring wells and stations is to provide a comprehensive Region-wide assessment of what current tools are available to WUGs and districts to monitor resources within the Plateau Region.

The Regional Model DCP will undoubtedly change over time to address particular needs and issues of the Region's users. The version of the model in this *Plan* will primarily focus on identifying all sources, users and monitoring tools in order to find the particular components within the Region that are not currently incorporated into any existing drought plan but could potentially utilize existing data resources. Another focus of this model plan will consider consistency of existing plans within the Region. Entities that have adopted drought plans will only be assessed to this end, therefore fine-tuning existing triggers of existing municipal drought plans is not a goal of the model plan beyond an effort toward achieving consistent responses/actions to drought across the Region. Triggers have been recommended and are listed in Table 7-2 that are consistent with existing Municipal and GCD plans. An effort has been made to make the percent reduction of demand/use slightly more aggressive and more equitable. Additionally, "voluntary conservation" has been removed as a stage 1 action. Conservation is a Best Management Practice (BMP) that ideally will ultimately be practiced daily, and not merely as a reaction to drought conditions, therefore it has been removed as an action in the Regional Model DCP.

Smaller PWS entities (county-other), manufacturing, power, and irrigation water wells that exceed GCD exempt well production thresholds are subject to drought actions imposed by the conservation districts. Exempt well users are requested to voluntarily follow the actions specified by the Districts for non-exempt users. Generally, the water user groups within the Region that are not included in these plans (or included on a voluntary basis) are: (1) all exempt water wells in counties with established GCDs, and (2) all users in Val Verde County except those who are provided water by the City of Del Rio.

Table 7-9. Recommended Regional Drought Plan Triggers and Actions

Source Name	Source Type (SW or GW)	Source User Entity	Current WUG Monitoring	Real-time Source Monitoring	Factors to be Considered	Recommendations	Specific Triggers								Specific Actions (Percent Reduction Demand/ Use)							
							Source Manager *a				Users *b				Source Manager *c				Users *d			
							1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
							Mild	Mod	Severe	Critical	Mild	Mod	Severe	Critical	Mild	Mod	Severe	Critical	Mild	Mod	Severe	Critical
Edwards - Trinity (Plateau)	GW	City of Rocksprings	55-63-803 (Sharp well)	---	Plan in place	Add stage 4.	*a	*a	*a	*a					10	20	30	40	10	20	30	40
		City of Brackettville	70-45-601 (Well #1)	---	Plan in place	Add stage 4.	*a	*a	*a	*a					10	15	25	35	10	15	25	35
		Fort Clark Springs MUD	70-45-504 (Well #1)	---	Plan in place	Remove voluntary conservation as a stage	*a	*a	*a	*a					10	15	25	35	10	15	25	35
		City of Del Rio	No groundwater triggers	---	Plan in place	Make stage 1 a 10% demand reduction.	*a	*a	*a	*a					10	20	30	40	10	20	30	40
		Laughlin AFB									*b	*b	*b	*b								
		County Other	N/A	69-12-206 (Bandera) 56-64-302 (Kerr) 54-63-401 (Val Verde) 70-01-707 (Val Verde)	District plans in place	Make stage 1 a 10% demand reduction (REGRD only).					*b	*b	*b	*b	10	20	30	40	10	20	30	40
		Irrigation									*b	*b	*b	*b								
		MAN, MIN									*b	*b	*b	*b								
Trinity	GW	City of Bandera	Groundwater triggers	TWDB 69-24-225	Plan in place	Remove voluntary conservation as a stage.	*a	*a	*a	*a					10	20	35	50	10	20	35	50
		City of Kerrville	Comparison of demand and safe operation capacity	---	Plan in place	No change.	*a	*a	*a	*a					*c	*c	*c	*c				
		City of Ingram	Demand-based triggers	---	Plan in place	Remove voluntary conservation as a stage. Make stage 1 a 10% demand reduction.	*a	*a	*a	*a					10	20	30	40	10	20	30	40
		County Other	N/A	56-54-405 (Kerr) 56-63-922 (Kerr) 69-19-401 (Real) 16 HGCD wells (Kerr)	District plans in place	No change.					*b	*b	*b	*b	10	20	30	40	10	20	30	40
		Irrigation																				
		MAN, MIN																				
Edwards (BFZ)	GW	County Other	N/A	70-38-902 (Kinney)	No drought plan	No change.					*b	*b	*b	*b					*d	*d	*d	*d
		Irrigation																				
		MAN, MIN																				
Austin Chalk	GW	County Other	N/A	---	No drought plan	No change.					*b	*b	*b	*b					*d	*d	*d	*d
		Irrigation																				
		MAN, MIN																				
Frio River Alluvium	GW	City of Leakey	N/A	---	District plan in place	Remove voluntary conservation as a stage.					*b	*b	*b	*b	10	20	30	40	10	20	30	40
		Irrigation	N/A																			
		County Other																				
Nueces River Alluvium	GW	Community of Barksdale	Unknown	---	District plan in place	Remove voluntary conservation as a stage.					*b	*b	*b	*b	10	20	30	40	10	20	30	40
		Irrigation	N/A																			
		County Other																				

Notes:

*a Source Manager Triggers – See Table 7-1 for specific triggers in Municipal and GCD drought management plans.
*b User Triggers – Follow local Municipal or GCD drought management plans as shown in Table 7-1.
*c Source Manager Action – See Table 7-1 for specific triggers in Municipal and GCD drought management plans.
*d User Action – Follow local Municipal or GCD drought management plans as shown in Table 7-1.

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Table 7-9. (continued) Recommended Regional Drought Plan Triggers and Actions

Source Name	Source Type (SW or GW)	Source User Entity	Current WUG Monitoring	Real-time Source Monitoring	Factors to be Considered	Recommendations	Specific Triggers								Specific Actions (Percent Reduction Demand/ Use)							
							Source Manager *a				Users *b				Source Manager				Users			
							1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
							Mild	Mod	Severe	Critical	Mild	Mod	Severe	Critical	Mild	Mod	Severe	Critical	Mild	Mod	Severe	Critical
Rio Grande Basin																						
Las Moras Springs	SW	City of Brackettville	N/A	USGS station 08456300 and 08456310	Plan in place	Add stage 4.	*a	*a	*a	*a					10	15	25	35	10	15	25	35
San Felipe Springs		City of Del Rio	stages triggered by spring discharge and storage reservoirs	IBWC station 08-4530.00	Plan in place	Increase stage 1 to a 10% demand reduction.	*a	*a	*a	*a					10	20	30	40	10	20	30	40
San Felipe Creek			N/A	IBWC station 08-4530.00	No drought plan						*b	*b	*b	*b					*d	*d	*d	*d
Rio Grande		County Other		IBWC station 08-3772.00																		
Pecos River		Irrigation		USGS station 08447410																		
Devils River		MAN, MIN		USGS station 08449100																		
Amistad Reservoir				IBWC station 08-4508.00																		
Cienegas Creek				---																		
Nueces River Basin																						
Old Faithful Springs	SW	City of Camp Wood	RECRD weir box; based on system capacity limits	RECRD weir box	Plan in place	Remove voluntary conservation as a stage. Make stage 1 a 10% mandated demand reduction.	*a	*a	*a	*a					10	20	30	40	10	20	30	40
West Nueces River			RECRD monitors two gages RECRD monitors six gages	USGS station 08190500	No drought plan						*b	*b	*b	*b					*d	*d	*d	*d
Nueces River Basin		County Other		USGS station 0818999010																		
Frio River		Irrigation		USGS station 08194840																		
Sabinal River		MAN, MIN		USGS station 08197936																		
Hondo Creek				N/A																		
Colorado River Basin																						
Llano River	SW	County Other	RECRD monitors two gages	Telegraph crossing, Hwy 377 at Evergreen School crossing	District plans in place (HGCD and REGRD)	Make stage 1 a 10% demand reduction (REGRD only).					*b	*b	*b	*b	10	20	30	40	10	20	30	40
		Irrigation																				
		MAN, MIN																				

Notes:

*a Source Manager Triggers – See Table 7-1 for specific triggers in Municipal and GCD drought management plans.
*b User Triggers – Follow local Municipal or GCD drought management plans as shown in Table 7-1.
*c Source Manager Action – See Table 7-1 for specific triggers in Municipal and GCD drought management plans.
*d User Action – Follow local Municipal or GCD drought management plans as shown in Table 7-1.

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Table 7-9. (continued) Recommended Regional Drought Plan Triggers and Actions

Source Name	Source Type (SW or GW)	Source User Entity	Current WUG Monitoring	Real-time Source Monitoring	Factors to be Considered	Recommendations	Specific Triggers								Specific Actions (Percent Reduction Demand/ Use)							
							Source Manager *a				Users *b				Source Manager				Users			
							1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
							Mild	Mod	Severe	Critical	Mild	Mod	Severe	Critical	Mild	Mod	Severe	Critical	Mild	Mod	Severe	Critical
San Antonio River Basin																						
Medina River	SW	County Other	N/A	USGS stations 0817887350, 08178880, and 08178980							*b	*b	*b	*b					*d	*d	*d	*d
Medina Lake		Irrigation, MAN, Min	N/A	USGS station 08179500																		
Guadalupe River Basin																						
Guadalupe River	SW	City of Kerrville	Comparison of demand and safe operation capacity	---	Plan in place	No change.	*a	*a	*a	*a					*c	*c	*c	*c	*d	*d	*d	s
		County Other	N/A	USGS stations 08165300, 08165500, 08166000, 08166140, 08166200, and 08166250	District plan in place	No change.					*b	*b	*b	*b	10	20	30	40	10	20	30	40
		Irrigation, MAN, Min	N/A								*b	*b	*b	*b					*d	*d	*d	*d

Notes:

*a Source Manager Triggers – See Table 7-1 for specific triggers in Municipal and GCD drought management plans.

*b User Triggers – Follow local Municipal or GCD drought management plans as shown in Table 7-1.

*c Source Manager Action – See Table 7-1 for specific triggers in Municipal and GCD drought management plans.

*d User Action – Follow local Municipal or GCD drought management plans as shown in Table 7-1.

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7.6.4 Model DCP

In 2019, the DPC recommended that a model DCP be in place for any water user group that exceeds ten percent of the Region's water demands. For the Plateau Region, these user groups include irrigation and municipal. Based on this recommendation, model DCPs for municipal and irrigation, along with wholesale, are available under the heading of MODEL DROUGHT CONTINGENCY PLANS on the Plateau Region Water Plan website.

7.6.4.1 Public Water Supplier

DCP have previously been adopted by the majority of the public suppliers and municipalities in the Plateau Region, although some suppliers did not provide any adopted plans. Current triggers and response actions for participating entities are summarized in Table 7-2.

7.6.4.2 Irrigation

Irrigation wells located within a municipality are subject to the triggers and response actions designated by the city's drought plan. Non-exempt irrigation wells located outside of a municipality but within a GCD are subject to the triggers and response actions of the GCD. Exempt irrigation wells located within a GCD are requested to comply voluntarily with response actions that have been mandated for non-exempt well owners. No response actions have been designated for irrigators located in Val Verde County except for those located within the City of Del Rio's jurisdictional boundary.

7.6.4.3 Wholesale Water Provider

The only wholesale water provider in the Plateau Region is the City of Del Rio. Generally, triggers are invoked when water levels in the Bedell Street Storage Reservoirs are less than a designated depth and San Felipe Spring flow drops below a specific flow rate. Currently adopted triggers and actions are summarized below in Table 7-10.

Table 7-10. City of Del Rio Drought Triggers and Response Actions

Stage & Description	1 – Mild	2 – Moderate	3 – Severe	4 – Extreme	5 – Emergency
Trigger	Water levels in the Bedell Street Storage Reservoir do not recover to 100% full during a 24-hour period; or are less than 30 ft. at any time;	Maximum water levels decrease over three consecutive days; or water levels are less than 25 ft. at any time;	Maximum water levels decrease over five consecutive days; or water levels are less than 20 ft. at any time;	Maximum water levels decrease over seven consecutive days; or water levels are less than 15 ft. at any time;	Water levels are less than 10 feet;
	San Felipe Spring flow is less than 25 mgd.	San Felipe Spring flow is less than 20 mgd.	San Felipe Spring flow is less than 15 mgd.	San Felipe Spring flow is less than 10 mgd.	San Felipe Spring flow is less than 5 mgd.
Conservation Goal (percent reduction in pumpage)	Reduce demand to 95% of the 30-day average prior to initiation	Reduce demand to 93% of the 30-day average prior to initiation	Reduce demand to 90% of the 30-day average prior to initiation	Restrictions to ensure adequate water supply for public health and safety, as demonstrated by meeting minimum system pressure requirements and fire flow demands.	Notify state

7.7 DROUGHT WATER MANAGEMENT STRATEGIES

The PWPG has designated drought management strategies (J-12 and J-15) for the Bandera County Other category to be administered by the Bandera County River Authority and Groundwater District. Drought management stages by the District are triggered by the U.S. Drought Monitor and adjusted at the discretion of the District when aquifer levels, rainfall and river flow conditions warrant. Drought management is considered a temporary measure aimed at conserving available water supplies during times of drought or emergencies. Drought management is most adequately addressed in the Region through the implementation of local DCP. The PWPG is supportive of the development and use of these plans during periods of drought or emergency water needs.

7.8 OTHER DROUGHT-RELATED CONSIDERATIONS AND RECOMMENDATIONS

7.8.1 Texas DPC and Drought Preparedness Plan

In accordance with TWDB rules, all relevant recommendations from the DPC were considered in the writing of this Chapter. The Texas DPC is composed of representatives from multiple State agencies and plays an important role in monitoring drought conditions, advising the governor and other groups on significant drought conditions, and facilitating coordination among local, State, and Federal agencies in drought-response planning. The Council meets regularly to discuss drought indicators and conditions across the State and releases Situation Reports summarizing their findings. Additionally, the Council has developed the State Drought Preparedness Plan, which sets forth a framework for approaching drought in an integrated manner to minimize impacts to people and resources. The Plateau Region supports the ongoing efforts of the Texas DPC and recommends that water providers and other interested parties regularly review the Situation Reports as part of their drought monitoring procedures. The Council provided three new recommendations in 2024 to all RWPGs which are addressed in this chapter.

- The regional water plans and state water plan shall serve as water supply plans under DOR conditions. The DPC encourages regional water planning groups to consider planning for drought conditions worse than the DOR, including scenarios that reflect greater rainfall deficits and/or higher surface temperatures.
- The DPC encourages regional water planning groups to incorporate projected future reservoir evaporation rates in their assessments of future surface water availability.
- The DPC encourages regional water planning groups to identify in their plans utilities within their boundaries that reported having less than 180 days of available water supply to the TCEQ during the current or preceding planning cycle. For systems that appeared on the 180-day list, RWPGs should perform the evaluation required by Texas Administrative Code Section 357.42(g), if it has not already been completed for that system.

To meet these recommendations, the PWPG has developed this Chapter to correspond with the sections of the outline template and has provided model DCPs for both municipal and irrigation users.

7.8.2 Other Drought Recommendations

The PWPG recognizes that while drought preparedness, including DCPs, are an important tool, in some instance's drought cannot be prepared for, it must be responded to. The PWPG maintains that DCPs developed by the local, individual water providers are the best available tool for drought management. The PWPG fully supports the use and implementation of individual DCPs during times of drought. The PWPG has reviewed provided DCPs and specific drought response strategies proposed in this *Plan* and find no unnecessary or counterproductive variations to exist.

CHAPTER 8
POLICY AND UNIQUE SITES RECOMMENDATIONS

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8 POLICY AND UNIQUE SITES RECOMMENDATIONS

The regional water planning process offers an opportunity to make recommendations pertaining to the development and management of the groundwater and surface water resources of the State of Texas. This chapter contains specific suggestions and decisions made by the PWPG. Regional water planning remains a learning and improving process for the State of Texas. Because of the complex nature of this undertaking, many ideas, and approaches to the problems of water resource management are either refined or changed significantly as all participants in the planning process learn more about the Region's water resources and about what is required to produce a plan that will benefit all areas of the Region. The PWPG supports the continuation of the regional planning process and recommends certain modifications intended to strengthen its effectiveness.

The following recommendations by the PWPG are derived from careful consideration of many issues covered during the planning exercise including needed legislative actions, State funding and assistance, water supply management planning, and needed studies and data. Issues concerning ecologically unique river and stream segments and sites for the construction of reservoirs are covered. The recommendations in the following sections are designed to present new and/or modified approaches to key technical, administrative, institutional, and policy matters that will help to streamline the planning process, and to offer guidance to future planners with regard to specific issues of concern within the Region.

8.1 CONSERVATION RECOMMENDATIONS

8.1.1 Watershed Management Practices

Selective vegetative (brush) management, as a tool to improve watershed yields and water quality, is a strategy of great interest in the Plateau Region, as well as in surrounding planning regions. A balanced approach to brush control contributes to the land's ability to absorb, retain, filter, and slow rainfall runoff. However, a narrow goal only to encourage the enhancement of runoff should be avoided.

The State should draft legislation based upon the best available science and input from all stakeholders to provide a cost-share funding program to landowners in the targeted watersheds for selective brush management and required other practices. It is generally recognized that brush infestations are the symptom of deeper ecological disturbances such as fire control, drought, grazing mismanagement, wildlife overpopulations and other causes. As such, the cost-share program should involve a long-range contract between the State and the landowner for at least 10 years of post-treatment management with required brush re-invasion treatments. To accurately assess the benefits, treated watersheds will require thorough monitoring of groundwater, springs and surface waters by appropriate State and Federal agencies. Information and assistance are available from the USDA Natural Resources Conservation Service (NRCS) and the Texas State Soil and Water Conservation Board.

Currently, TPWD has a program specifically developed for landowners involving brush management in areas possibly containing endangered species. As has been proven on the Kerr Wildlife Management Area (TPWD) with long-term studies, selective brush management coupled with good rangeland management can benefit endangered species and ranchers as well. It is highly likely that watershed values will fit into the same package to provide a win-win situation for all.

8.1.2 Riparian Stewardship

The interaction between soil, water and vegetation in the floodplains and along streambeds constitutes riparian function, which buffers and slows floodwaters, filters sediment, improves natural infiltration and recharge of alluvial aquifers, and enhances water quality. The PWPG encourages riparian landowners to learn and implement land stewardship practices that support healthy riparian function. The PWPG continues to encourage funding for projects aimed at the eradication and long-term suppression of salt cedar, Arundo donax, and other nuisance phreatophytes in the regional watersheds.

8.1.3 Conservation Management of State-Owned Lands

All State-owned land should be managed in ways that enhance water conservation. State agencies need to take the lead in water conservation, and it should start on State-owned properties. Unless State agencies set good conservation examples for the public, any public program encouraging such conservation will likely be perceived as "do as I say, not as I do," something that never plays well. Considering that approximately 95 percent of Texas land is privately owned, the State needs to be convincing when making recommendations to the public if it hopes to be successful.

8.1.4 Rainwater Harvesting as an Alternative Source of Water

Rainwater harvesting programs should be supported by the State. Rainwater harvesting is one way to meet rural or urban domestic water demands, as well as use for limited irrigation, such as vineyards, orchards or small farms under drip irrigation. Livestock and wildlife can also be provided supplemental water by rainwater harvesting. This should be widely encouraged by funded education programs and cost-share funding to individual homeowners, farmers, businesses, public entities, and ranchers.

8.1.5 Conservation and Drought Planning

Because portions of the Plateau Region are particularly susceptible to water-supply shortages during periods of drought conditions, these areas are especially encouraged to develop conservation-oriented management plans. Likewise, water-user entities within these areas should become actively involved in the regional water planning activities associated with this *Plan*.

8.1.6 Stormwater / Flood Planning

In 2019, the Texas Legislature passed Senate Bill 8 directing the creation of the first-ever State flood plan for Texas. The State flood plan brings together the findings of the 15 river-basin-based regional flood plans and makes legislature and floodplain management recommendations to guide State, regional, and local flood control policy.

The TWDB adopted Texas' inaugural 2024 State Flood Plan on August 15, 2024, to be delivered to the Legislature by September 1, 2024. The regional and State flood planning processes recur in five-year cycles.

The Plateau Region falls within six different flood planning regions, where the goal was to perform comprehensive planning to reduce flood risk and take a broad look at flood hazard across the State. The food planning process aims to identify who and what might be exposed to flooding; identify the State's major flood risk reduction infrastructure; consider existing floodplain management practices or lack thereof; and identify and recommend flood risk reduction solutions across the State.

Chapter 8 of the 2023 Regional Flood Plans outlines legislative recommendations developed by the Regional Flood Planning Groups, necessary to facilitate floodplain management and flood mitigation planning and implementation. The PWPG acknowledges the importance of being actively involved in the regional flood planning activities and will continue to coordinate efforts to support the detailed legislative recommendations within the regional water planning area.

8.1.7 Needed Funding for Data Collection in Rural Areas

Rural areas need to be able to access State funding to gather the information needed to draft a substantive regional plan. This funding is needed for test wells, monitoring equipment, observation wells, and modeling. The PWPG should be allowed to request additional funding for the data needs and contract for the studies.

8.2 WATER MANAGEMENT RECOMMENDATIONS

8.2.1 Headwaters GCD Access to Groundwater under State-Owned Land

The Texas Legislature recognizes that a landowner owns the groundwater below the surface of the landowner's land as real property (*Water Code Chapter 36.002 Ownership of Groundwater*). Water Code Chapter 36.104 states that a groundwater district may purchase, sell, transport and distribute surface water or groundwater. For the long-term benefit of meeting the future water demands of the citizens in Kerr County, Texas, the PWPG recommends that the State of Texas enter into a long-term lease agreement or contract that will allow the Headwaters GCD to retain/acquire the groundwater rights located under all State-owned property within the boundaries of Kerr County. This will provide for:

- better long-term management of local groundwater sources.
- additional drilling sites for test/monitor wells.
- more county-wide data collection and monitoring of aquifer conditions.
- increased availability of scientific data for local water management planning.

The District's enabling legislation (*Special District Local Laws Code Chapter 8842 Section 102.B*) states that the District may contract with a State agency or another governmental body to carry out any function of the District. The access right to groundwater underlying State-owned land would be included in the District's Management Plan.

8.2.2 GCD Management of Brackish Groundwater

Brackish-quality groundwater is recognized State-wide as an underutilized water-supply source, and programs are in place in the State's water agencies to encourage the development of this source to meet future water-supply shortages. Science recognizes that most of these brackish aquifers represent a down-dip component of an aquifer's freshwater zone, and that the withdrawal of water from the brackish portion may impact the updip fresh-water portion of the same aquifer. The Legislature has declared that GCDs are the State's recognized authority to locally manage groundwater sources. The PWPG affirms that local GCDs have the authority and should retain the authority to manage the brackish portion of aquifers.

8.2.3 Recharge Structures

Recharge structures are a relatively low-cost method of enhancing aquifer recharge if sited to provide adequate streambed water percolation based upon the best available science. Recharge structures such as small dams, gabions, or terraces can provide multiple benefits under ideal conditions as has been proven along the Edwards Aquifer Recharge Zone. This interest in recharge structures should be encouraged, funding provided, and perhaps some streamlining of any required permitting procedures as possible and as advised. Programs and funding should be available to identify appropriate locations for recharge structures and technical assistance provided for construction and maintenance.

8.3 WATER PLANNING RECOMMENDATIONS

8.3.1 Transient Population Impact on Water Demand

Municipal water use reports capture the total amount of water produced and distributed by the city. In concept, this volume includes water consumed by both permanent and transient populations within the community. However, the counties of the Plateau Region have a high transient influx of vacationers and hunters that frequent the more remote areas and are not likely included in the water demand estimates. Likewise, there are a high percentage of second-home owners in the rural counties that is also not accounted. Officials in the most rural counties in the Region estimate that as much as 70 percent of landowners are not permanent residents. This transient water demand likely has a significant impact on water demand estimates used by the planning group. The PWPG encourages the TWDB to consider this water-use category and develop a method for estimating its impact.

8.3.2 Better Methodologies for Estimating Population and Water Demand

The revision of population and demand estimates should be discussed by regional water planning groups and put before the public for several months, and then be presented to the planning groups for consideration and adoption. This will allow more time for water users within the Region to hear about the planning effort and to have input to the revisions of population, water demand, and water supply.

Modification of demand numbers should be allowed further into the planning process. Demand errors may not be discovered until the supply-demand analysis is performed. Some entities or water-use categories may have been overlooked early in the process and their demands need to be added later for the supply-demand analyses to match.

8.3.3 County-Other Demand Distribution

In the regional water planning process, water supply demand is determined on a county and river basin basis and is then evenly distributed over the designated area. In some cases, this results in a misrepresentation of the actual rural density within segments of the county-river basin area. The primary disadvantage of this is that a high-density rural area may have a legitimate need of water supply management even though the county-river basin statistical numbers do not indicate a supply shortage. A recommended water management strategy in an area such as this does not register as high of a priority as it realistically should. The PWPG therefore recommends that the TWDB develop a planning process that will justifiably recognize the high-priority needs of relatively higher-density county-other areas.

8.3.4 Irrigation Surveys

Irrigation application is the largest use of water in the State, yet its quantification is probably the least accurate. Irrigation use is only being accurately determined in areas where GCDs are requiring the installation of irrigation well flow meters and where irrigation districts record surface water diversions. Elsewhere, planning group members directly involved in the agricultural industry have viewed irrigation surveys with skepticism in many counties. Nursery farms, greenhouse operations, wildlife and exotic animal food plots, and non-municipal golf courses are just a few of the irrigation activities that are often overlooked in the surveys. The TWDB is encouraged to develop a more confident means of estimating actual irrigation use.

8.3.5 Peak-Use Management

Drought management plans need to be developed based on peak use demand instead of annual production capabilities. The current *Plan* is based on drought-of-record conditions on an annual basis. While this is a good starting point in the planning process, it would be beneficial to also plan based on peak demand during a year. For example, current planning does not address water needs during the peak use period of summer months. During the summer, in many areas of the State, severe water problems may exist that are not apparent based on an annual water management plan. This results in a plan that may indicate that water-supply needs are satisfied for a region, when in reality such needs may not be satisfied throughout the year. This presents a significant problem in the current planning process.

8.3.6 MAG Availability Alternative

MAG is the quantitative limit set by GMAs for groundwater use in a given area and is the cap for groundwater source use in regional water planning. The PWPG recommends that MAGs be used as the water planning cap unless the Planning Group obtains written permission from a GCD to allow a water management strategy to be recommended that uses more groundwater than the MAG cap. This approach assumes that the strategy is consistent with the GCD Management Plan but allows for minor supply shortages to be covered without excessive administrative actions and allows the GCD to apply local knowledge to account for variations in permitting approaches and usage patterns. The approach could also be used in areas with no GCDs.

8.3.7 Regional Planning Coordination

The two regional planning processes developed by the Legislature (Regional Water Planning and GMAs) have in some cases resulted in conflicting methodologies of reaching long-term planning goals. The PWPG encourages better communication between the stakeholders at earlier stages of both processes in the future. The PWPG also encourages the Legislature to examine ways in which both planning processes can better interact for the good of all citizens and economies in the impacted regions.

8.3.8 Training for New Regional Water Planning Group Members

The TWDB is encouraged to continue providing training opportunities for new planning group members. Planning group members provide better input to the planning process when they fully understand the requirements, schedules, and the multitude of internal components of the regional plan.

8.3.9 Require Participation of State Agencies Involved with the Planning Process

Representatives of State agencies involved in the regional planning process could effectively derail a regional plan at the end of the planning period - without attending as much as one meeting. The PWPG recommends that nonvoting members of State agencies be required to attend and provide input at every planning group meeting. If an agency's nonvoting representative does not contribute or fails to attend meetings, then that agency should not be permitted to object to or alter contents of a planning group's adopted plan. It should be noted that TWDB, TPWD, and TSSWCB staff were very active (and much appreciated) in the Plateau Region planning process.

8.4 WATER RESEARCH NEEDS

The State should fund or conduct specific studies that will shed more information on specific water resource issues. The questions unanswered by current sources of information are critical to future PWPG decisions. The following are recommendations pertaining to specific studies and data acquisition that the PWPG believes would provide significant insight into specific planning issues in the Region.

8.4.1 Edwards-Trinity (Plateau) Aquifer

All six counties in the Plateau Region are partially or fully underlain by the Edwards- Trinity (Plateau) Aquifer. Even though a groundwater availability model (GAM) has been constructed for this Aquifer, there remain many hydrological questions about the Aquifer. Specific counties are embroiled in controversy pertaining to groundwater supply availability. At issue is the disagreement about the total amount of water in the county that is available on an annual basis to meet all the counties projected water demands now and into the future, and the amount of groundwater more than that amount that might be available for other purposes other than in-county use. All concerned agree that sound science is needed to assess this quantification.

Specific concern has been voiced by citizens in Val Verde County where the groundwater source availability of the Edwards-Trinity (Plateau) Aquifer changed from 25,000 acre-feet per year in the 2016 Plateau Region Water Plan to 50,000 acre-feet per year in the 2021 Plan. TWDB modelers are particularly critical of the ability of any existing groundwater model to accurately assess Val Verde County groundwater availability as Aquifer properties are poorly defined in most of Val Verde County because there are few data on Aquifer responses to pumping stresses. A better understanding is needed of the different geohydrologic environments that exist between the southern San Felipe Springs – Amistad Reservoir area verses the upstream Pecos and Devil's River area.

A basic, unbiased, scientific study that encompasses the hydrologic characterization of the Edwards-Trinity (Plateau) Aquifer and adjacent associated aquifers (Edwards-BFZ and Austin Chalk) and the inter-formational flow between them, their contribution to surface water flows, and the historical withdrawal from the aquifers is needed in order for the local groundwater management entities and the PWPG to make sound management decisions and recommendations.

8.4.2 Unpermitted Withdrawals of Riparian Water

A significant amount of unpermitted riparian water is withdrawn from rivers and their tributaries in the Region. Unpermitted pumping is particularly escalated during drought periods when increased withdrawals occur for irrigation of lawns. This water use is unaccounted for in the WAMs that are developed for these waterways. State water agencies should devise a survey method to establish a reasonable estimate of these diversions.

8.4.3 Emphasis on Basic TWDB Water Evaluation Studies

In the past, the TWDB has provided significant knowledge concerning the groundwater resources in the State in the form of basic data and reports. The Board's current emphasis on groundwater modeling with its intended use as a water management planning tool is recognized as an important advancement in providing planning tools. However, the Board should not abandon its important basic data gathering and evaluation responsibility. The Board should emphasize more realistic and useful groundwater studies that include the extensive field data collection necessary for such studies.

8.4.4 Radionuclides in Trinity Aquifer Groundwater

Recent groundwater sampling by GCDs have identified elevated levels of radionuclides in the Trinity Aquifer. Further studies are needed to: (1) identify the specific source of the radionuclides, (2) map their areal distribution and concentration, (3) determine their health concerns, and (4) monitor their changing concentrations over time.

8.4.5 Groundwater/Surface Water Relationship

The PWPG defines groundwater availability as a maximum level of aquifer withdrawal that results in an acceptable level of long-term aquifer impact such that the base flow in rivers and streams is not significantly affected beyond a level that would be anticipated due to naturally occurring conditions. This water-supply policy definition can best be achieved when the relationship between groundwater and surface water is fully understood. The PWPG encourages the State (TWDB) to embrace this concept and focus water availability studies on this topic.

8.4.6 Impact of Transient Water Demand in Rural Counties

The concern pertaining to transient population water demand in rural counties was expressed in Section 8.1.8. A study is needed to quantify this impact that is not based solely on the resident population but rather considers the total count of individuals within the respective area.

8.4.7 Underestimated Water Demand of Exotic Animals

The PWPG investigated the water use generated by the expanding exotic animal industry within the Region (see Appendix 2B of the *2011 Plan*) and expects to build on this information to generate more accurate water demand estimates in future regional plans. The PWPG encourages the TWDB and other agencies to continue funding for this endeavor in the Plateau Region and throughout the State.

8.4.8 Upper Guadalupe River Basin Groundwater/Spring Flow Analysis

Surface water base flow in the three branches of the upper Guadalupe River in western Kerr County is derived almost exclusively from groundwater discharge through springs. Both the PWPG and members of GMA 9 recognize the need to manage groundwater use in this area where critical surface water/groundwater interaction occurs. However, developing management decisions is impaired by the lack of current understanding of how groundwater level elevations relate to spring flow rates. Only one monitoring well is in place that provides continuous water level readings, and no attempt has thus far been made to relate this recent data to spring flows. A study is needed to evaluate this critical interaction so that future management decisions can be based on a more substantial level of scientific knowledge.

8.5 CONSIDERATION OF ECOLOGICALLY UNIQUE RIVER AND STREAM SEGMENTS

Under regional planning guidelines (§357.43), 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.

TPWD provided a list of stream segments that were identified as meeting ecologically unique criteria. This list and map can be viewed in Appendix 8B of the 2011 Plan. For each segment, TPWD lists qualities of each segment that support the stream's candidacy. These qualities may include but are not limited to biological function, hydrological function, location with respect to conservation areas, water quality, the presence of State- or Federally listed threatened or endangered species, and the critical habitat for such species.

The Plateau Region contains some of the most ecologically pristine areas in the State. The preservation of this natural environment is an important component of the Region's economy, which is closely tied to these natural resources. The PWPG recognizes the uniqueness of this Region and has followed a policy throughout this planning period of always considering the impact that their decisions have on the area's ecological resources. The PWPG also recognize the extent of Region L designated ecologically unique stream segments that extend upstream to the southern boundary of the Plateau Region.

The PWPG has established the following procedure for public requests for Planning Group consideration of an ecologically unique stream segments:

- PWPG must receive a clearly designated letter and map requesting the EUSS. Letter must be from an individual or entity that resides or principal office is within the geographic boundary of the Plateau Water Planning Region.
- All property owners within the recommended designated area must be provided written notice by certified mail of the proposed designation.
- At least two thirds of the property owners that respond within the recommended area must concur with the proposed EUSS recommended designation.
- The County Commissioners' Court must vote in favor of the recommended designation and submit to the PWPG.

However, because the subsequent ramifications of designation are not fully understood, the PWPG, in keeping its respect toward all individual landowners along these segments and their private property rights, has chosen to refrain from recommending specific segments for designation as "ecologically unique" currently. The PWPG strongly maintains that all river and stream segments in the Plateau Region are vitally important, and their flows constitute a major consideration in adoption of this *2026 Plan*.

The UGRA Board of Directors has presented the following letter in expression of their concern for possible ramifications of RWPGs recommending Ecologically Unique River and Stream Segments:

> *Based on 31 TAC §357.43 a regional water planning group (RWPG) may recommend a river or stream segment as being of unique ecological value based on the criteria set forth in 31 TAC §358.2(6). Consideration of the designation of stream segments of unique ecological value (unique stream segments) is a component of regional water planning throughout the State. For some, however, including the Plateau Region (J), there is a significant concern about the use of unique stream segments because of a lack of clarity about how the designation might be used in the future. In particular, there are concerns about the provision being used for purposes other than the intent of the legislature, usurping local control, and resulting in the restriction of individual and private property rights for landowners.*
>
> *31 TAC §358.2(6) states the following: River and stream segments of unique ecological value--Those river or stream segments that may be identified by the Texas Water Development Board in coordination with the Texas Parks and Wildlife Department and the Commission or identified in an approved regional water plan based on the following criteria: (A) Biological function--stream segments which display significant overall habitat value including both quantity and quality considering the degree of biodiversity, age, and uniqueness observed and including terrestrial, wetland, aquatic, or estuarine habitats; (B) Hydrologic function--stream segments which are fringed by habitats that perform valuable hydrologic functions relating to water quality, flood attenuation, flow stabilization, or groundwater recharge and discharge; (C) Riparian conservation areas--stream segments which are fringed by significant areas in public ownership including state and federal refuges, wildlife management areas, preserves, parks, mitigation areas, or other areas held by governmental organizations for conservation purposes, or stream segments which are fringed by other areas managed for conservation purposes under a governmentally approved conservation plan; (D) High water quality/exceptional aquatic life/high aesthetic value--stream 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; or (E) Threatened or endangered species/unique communities--sites along stream where water development projects would have significant detrimental effects on state or federally listed threatened and endangered species; and sites along streams significant due to the presence of unique, exemplary, or unusually extensive natural communities.*
>
> *Designation of a river or stream segment as ecologically unique is defined by Chapter 16 of the Texas Water Code §16.051(f) to mean "…that a state agency or political subdivision of the state may not finance the actual construction of a reservoir in a specific river or stream designated by the legislature…". When the first regional water plans were prepared in 2001, the RWPGs requested clarification of the intent of unique stream segment designations. The legislature addressed that issue in the 77th Legislative Session which is reflected in Chapter 16 of the Texas Water Code §16.051(f) cited earlier. This implies that it would be irrelevant to consider recommending a segment for designation if it does not have potential to be a reservoir site. In other words, no regulatory purpose has been identified that would be served by a unique stream segment designation other than precluding reservoir construction with state funding.*

Despite the clarification by the 77th Legislature, many regional water planning groups (including Region J) have struggled with requests for the designation of a stream segment(s) in their respective planning areas based on criteria other than that which was identified by the 77th Legislature. There is considerable concern from some planning group members that using this provision for other than its original intent, which is to prevent a state agency or political subdivision of the state from financing the actual construction of a reservoir in a specific river or stream designated by the legislature under this provision, will lead to additional unwarranted restrictions on the use of the segment which can negatively impact individual landowners and infringe on private property rights.

Because the subsequent ramifications of unique stream designations are not fully understood, the use of the designation for anything other than the original intent could lead to the impingement of individual and private property rights, and costly litigation. The intent of the Texas Legislature regarding the purpose of the unique stream segment designation is clearly stated in Section 16.051(f) of the Texas Water Code. The current process incorporates considerations made by rule which exceed the legislature's intent and §16.051(f) of the Texas Water Code thereby usurping local control and due process by duly elected local officials.

Recommendation:

The Plateau Water Planning Group recommends the modification of 31 TAC §358.2 by striking subsection 6 (a through e) "Ecologically Unique Stream Segments" and the modification of sections that reference 31 TAC §358.2(6) with the rationale that this section's instruction for unique stream designation supersedes the directive in Texas Water Code 16.051(f). Striking 31 TAC §358.2(6) will additionally preserve and protect local control as well as individual and personal property rights.

8.6 CONSIDERATION OF UNIQUE SITES FOR RESERVOIR CONSTRUCTION

Regional water planning guidelines (§357.43) instruct that planning groups may recommend sites of unique value for construction of reservoirs by including descriptions of the sites, reasons for the unique designation, and expected beneficiaries of the water supply to be developed at the site. The following criteria shall be used to determine if a site is unique for reservoir construction:

1. Site-specific reservoir development is recommended as a specific water management strategy or in an alternative long-term scenario in an adopted plan.
2. The location, hydrologic, geologic, topographic, water availability, water quality, environmental, cultural, and current development characteristics, or other pertinent factors make the site uniquely suited for:
    - reservoir development to provide water supply for the current planning period; or
    - where it might reasonably be needed to meet needs beyond the 50-year planning period.

Following consideration of the above criteria the PWPG makes no recommendation of unique sites for reservoir construction.

CHAPTER 9

IMPLEMENTATION AND COMPARISON TO THE PREVIOUS REGIONAL WATER PLAN

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9 IMPLEMENTATION AND COMPARISON TO THE PREVIOUS REGIONAL WATER PLAN

Chapter 9 provides a survey of the level of implementation and identified impediments to the development of previously (*2021 Plan*) recommended Water Management Strategies that have affected progress in meeting projected water-supply needs. To best appreciate the continued improvements to the Plateau Region water planning process, this Chapter offers a comparison of key components in the *2021 Plateau Region Water Plan* to those in this current *2026 Plateau Region Water Plan*. This chapter also assesses the progress of the Plateau planning area in encouraging cooperation between water user groups for achieving economies of scale and otherwise incentivizing strategies that benefit the entire Region.

9.1 IMPLEMENTATION OF PREVIOUS REGIONAL WATER PLAN

Information needed to report on the level of implementation and identified impediments to the development of previously (*2021 Plan*) recommended Water Management Strategies that have affected progress in meeting projected water-supply needs was collected through an emailed survey and follow-up messages were delivered one month after first delivery and in a subsequent message to the PWPG to encourage further responses. Additional methods that were considered for identifying projects that may potentially have been implemented include:

- Identification of Potentially Infeasible WMSs scope-of-work.
- Tracking changes since the last Plan.
- Using TWDB funding records.
- Using conservation implementation reports submitted to the TWDB.

A summary of the survey results is provided in Table 9-1.

Table 9-1. 2026 Plateau Region Strategy Implementation Survey

WMS or WMS Project Name	Database Online Decade	Related Sponsor Entity and/or Benefitting WUGs	Has Sponsor taken affirmative vote or action? (TWC 16.053(h)(10))	What is the status of the WMS project or WMS recommended in the 2022 SWP?	If the project has not been started or no longer is being pursued, please explain why.	Project Impediment(s)	Other Project Impediments (not shown in Column G)	What funding type(s) are being used for the project?	Optional Comments
Reuse treated wastewater effluent for irrigation of public spaces [City of Bandera]	2030	City of Bandera	Yes	Started	N/A	N/A	N/A	State	
Promote, design & install rainwater harvesting systems on public buildings [City of Bandera]	2030	City of Bandera	Yes	Started	N/A	N/A	N/A	Unknown	
Additional Middle Trinity wells within City water infrastructure area [City of Bandera]	2020	City of Bandera	Yes	Started	N/A	N/A	N/A	State	
Surface water acquisition, treatment and ASR [City of Bandera]	2030	City of Bandera	Yes	Started	N/A	N/A	N/A	Unknown	
Public conservation education [Bandera County FWSD #1]	2020	Bandera County FWSD #1	Yes	Started	N/A	N/A	N/A	Private	
Additional groundwater well [Bandera County FWSD #1]	2020	Bandera County FWSD #1	Yes	Not Started	Timing of On-line Decade has Changed	Shift in Timeline	N/A	N/A	
Water loss audit & main-line repair [Bandera County-Other | Bandera River Ranch #1]	2020	Bandera River Ranch #1	Yes	Started	N/A	N/A	N/A	Private	
Public conservation education [Bandera County-Other | Lake Medina Shores]	2020	Lake Medina Shores	Yes	Started	N/A	N/A	N/A	Private	
Public conservation education [Bandera County-Other | Medina WSC]	2020	Medina WSC	Yes	Started	N/A	N/A	N/A	Private	
Additional groundwater well [Bandera County-Other | Medina WSC]	2020	Medina WSC	Yes	Started	N/A	N/A	N/A	Private	
Drought management (BCRAGD) [Bandera County-Other | Nueces River Basin]	2020	BCRAGD	Yes	Started	N/A	N/A	N/A	Private	
Drought management (BCRAGD) [Bandera County-Other | San Antonio River Basin]	2020	BCRAGD	Yes	Started	N/A	N/A	N/A	Private	
Water loss audit & main-line repair [Bandera County-Other | Enchanted River Estates]	2020	Enchanted River Estates	Yes	Started	N/A	N/A	N/A	Private	
Irrigation Scheduling [Bandera County | Irrigation]	2020	Bandera | Irrigation	Yes	Started	N/A	N/A	N/A	Private	
Additional groundwater wells [Bandera County | Irrigation]	2020	Bandera | Irrigation	Yes	Not Started	Project Sponsor Not Identified	Project Sponsor Not Identified	N/A	Unknown	
Livestock conservation [Bandera County Livestock | Nueces River Basin]	2020	Bandera | Livestock	Yes	Not Started	Project Sponsor Not Identified	Project Sponsor Not Identified	N/A	Unknown	
Livestock conservation [Bandera County Livestock | Guadalupe River Basin]	2020	Bandera | Livestock	Yes	Not Started	Project Sponsor Not Identified	Project Sponsor Not Identified	N/A	Unknown	
Additional groundwater well [Bandera County | Livestock Nueces River Basin]	2020	Bandera | Livestock	Yes	Not Started	Project Sponsor Not Identified	Project Sponsor Not Identified	N/A	Unknown	
Additional groundwater well [Bandera County Livestock | Guadalupe River Basin]	2020	Bandera | Livestock	Yes	Not Started	Project Sponsor Not Identified	Project Sponsor Not Identified	N/A	Unknown	
Public conservation education [City of Rocksprings]	2020	City of Rocksprings	Yes	Started	N/A	N/A	N/A	Private	
Additional groundwater well [City of Rocksprings]	2021	City of Rocksprings	Yes	Started	N/A	N/A	N/A	Private	

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Table 9-1. (continued) 2026 Plateau Region Strategy Implementation Survey

WMS or WMS Project Name	Database Online Decade	Related Sponsor Entity and/or Benefitting WUGs	Has Sponsor taken affirmative vote or action? (TWC 16.053(h)(10))	What is the status of the WMS project or WMS recommended in the 2022 SWP?	If the project has not been started or no longer is being pursued, please explain why.	Project Impediment(s)	Other Project Impediments (not shown in Column G)	What funding type(s) are being used for the project?	Optional Comments
Additional well in the Nueces River Alluvium Aquifer & RO wellhead treatment [Edwards County-Other | Barksdale WSC]	2020	Barksdale WSC	Yes	Started	N/A	N/A	N/A	State	TWDB Project #62937
Additional groundwater wells [Edwards County Mining | Guadalupe River Basin]	2020	Edwards | Mining	Yes	Started	Project Sponsor Not Identified	Project Sponsor Not Identified	N/A	Unknown	
Additional groundwater well [Edwards County Mining | Colorado River Basin]	2020	Edwards | Mining	Yes	Started	Project Sponsor Not Identified	Project Sponsor Not Identified	N/A	Unknown	
Additional groundwater well [Edwards County Mining | Nueces River Basin]	2020	Edwards | Mining	Yes	Started	Project Sponsor Not Identified	Project Sponsor Not Identified	N/A	Unknown	
Increase wastewater reuse [City of Kerrville]	2020	City of Kerrville	Yes	Not Started	Growth Driven	Shift in Timeline	N/A	Unknown	
Water loss audit & main-line repair [City of Kerrville]	2020	City of Kerrville	Yes	Started	N/A	N/A	N/A	Private	
Explore & develop new Ellenburger Aquifer well supply [City of Kerrville]	2020	City of Kerrville	Yes	Completed	N/A	N/A	N/A	Private	
Increased water treatment and ASR capacity [City of Kerrville]	2030	City of Kerrville	Yes	Started	N/A	N/A	N/A	Unknown	
Construction of an Ellenburger Aquifer water supply well [Kerr County-Other | EKCRWSP]	2030	Kerr County-Other	Yes	Completed	N/A	N/A	N/A	Private	
Construction of off-channel surface water storage [Kerr County-Other | EKCRWSP]	2030	Kerr County-Other	Yes	Not Started	New wastewater collection system project took priority	Shift in Timeline	N/A	N/A	
Construction of surface water treatment facilities & transmission line [Kerr County-Other | EKCRWSP]	2030	Kerr County-Other	Yes	Not Started	New wastewater collection system project took priority	Shift in Timeline	N/A	Unknown	
Construction of ASR [Kerr County-Other | EKCRWSP]	2030	Kerr County-Other	Yes	Not Started	New wastewater collection system project took priority	Shift in Timeline	N/A	Unknown	
Construction of Trinity Aquifer wellfield for dense, rural areas [Kerr County-Other | EKCRWSP]	2030	Kerr County-Other	Yes	Not Started	New wastewater collection system project took priority	Shift in Timeline	N/A	Unknown	
Construction of desalination plant [Kerr County-Other | EKCRWSP]	2030	Kerr County-Other	Yes	Not Started	New wastewater collection system project took priority	Shift in Timeline	N/A	Unknown	
Public conservation education [Kerr County-Other | Center Point]	2020	Center Point	Yes	Started	N/A	N/A	N/A	Private	
Purchase water from EKCRWSP [Kerr County-Other | Center Point]	2020	Center Point	Yes	Not Started	EKCRWSP is not yet online	Shift in Timeline	N/A	N/A	
Public conservation education [Kerr County-Other | Center Point Taylor]	2020	Center Point	Yes	Started	N/A	N/A	N/A	Private	
Purchase water from EKCRWSP [Kerr County-Other | Center Point Taylor]	2020	Center Point	Yes	Not Started	EKCRWSP is not yet online	Shift in Timeline	N/A	N/A	

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Table 9-1. (continued) 2026 Plateau Region Strategy Implementation Survey

WMS or WMS Project Name	Database Online Decade	Related Sponsor Entity and/or Benefitting WUGs	Has Sponsor taken affirmative vote or action? (TWC 16.053(h)(10))	What is the status of the WMS project or WMS recommended in the 2022 SWP?	If the project has not been started or no longer is being pursued, please explain why.	Project Impediment(s)	Other Project Impediments (not shown in Column G)	What funding type(s) are being used for the project?	Optional Comments
Water loss audit & main-line repair [Kerr County-Other | Verde Park Estates]	2020	Verde Park Estates	Yes	Started	N/A	N/A	N/A	Private	
Public conservation education [Kerr County-Other | Nueces River Basin]	2020	Kerr County-Other	Yes	Started	N/A	N/A	N/A	Private	
Livestock conservation [Kerr County Livestock | Colorado River Basin]	2020	Kerr County Livestock	Yes	Not Started	Project Sponsor Not Identified	Project Sponsor Not Identified	N/A	Unknown	
Livestock conservation [Kerr County Livestock | Guadalupe River Basin]	2020	Kerr County Livestock	Yes	Not Started	Project Sponsor Not Identified	Project Sponsor Not Identified	N/A	Unknown	
Livestock conservation [Kerr County Livestock | Nueces River Basin]	2020	Kerr County Livestock	Yes	Not Started	Project Sponsor Not Identified	Project Sponsor Not Identified	N/A	Unknown	
Livestock conservation [Kerr County Livestock | San Antonio River Basin]	2020	Kerr County Livestock	Yes	Not Started	Project Sponsor Not Identified	Project Sponsor Not Identified	N/A	Unknown	
Additional groundwater wells [Kerr County Mining]	2020	Kerr County Mining	Yes	Not Started	Project Sponsor Not Identified	Project Sponsor Not Identified	N/A	Unknown	
Increase supply to Spofford with new water line [City of Brackettville]	2030	City of Brackettville	Yes	Not Started	Economic Feasibility / Financing	Economic Feasibility / Financing	N/A	N/A	
Increase storage facility [City of Brackettville]	2030	City of Brackettville	Yes	Not Started	Economic Feasibility / Financing	Economic Feasibility / Financing	N/A	N/A	
Water loss audit & main-line repair [Fort Clark Springs MUD]	2020	Fort Clark Springs MUD	Yes	Started	N/A	N/A	N/A	Private	
Increase storage facility [Fort Clark Springs MUD]	2020	Fort Clark Springs MUD	Yes	Not Started	Economic Feasibility / Financing	Economic Feasibility / Financing	N/A	N/A	
Public conservation education [City of Camp Wood]	2020	City of Camp Wood	Yes	Started	N/A	N/A	N/A	Private	
Additional groundwater wells [City of Camp Wood]	2020	City of Camp Wood	Yes	Started	N/A	N/A	N/A	State	
Additional groundwater well [City of Leakey]	2020	City of Leakey	Yes	Started	N/A	N/A	N/A	Unknown	
Develop interconnections between wells within the City [City of Leakey]	2030	City of Leakey	Yes	Started	N/A	N/A	N/A	Unknown	
Water loss audit & main-line repair [Real County-Other | Real WSC]	2020	Real WSC	Yes	Started	N/A	N/A	N/A	Private	
Additional groundwater well [Real County-Other | Oakmont Saddle Mountain WSC]	2020	Oakmont Saddle Mountain WSC	Yes	Not Started	Economic Feasibility / Financing	Economic Feasibility / Financing	N/A	N/A	
Water loss audit & main-line repair [City of Del Rio]	2020	City of Del Rio	Yes	Started	N/A	N/A	N/A	State	TWDB Project #61580
Additional groundwater well [City of Del Rio]	2020	City of Del Rio	Yes	Started	N/A	N/A	N/A	Unknown	

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Table 9-1. (continued) 2026 Plateau Region Strategy Implementation Survey

WMS or WMS Project Name	Database Online Decade	Related Sponsor Entity and/or Benefitting WUGs	Has Sponsor taken affirmative vote or action? (TWC 16.053(h)(10))	What is the status of the WMS project or WMS recommended in the 2022 SWP?	If the project has not been started or no longer is being pursued, please explain why.	Project Impediment(s)	Other Project Impediments (not shown in Column G)	What funding type(s) are being used for the project?	Optional Comments
Water treatment plant expansion [City of Del Rio]	2030	City of Del Rio	Yes	Not Started	Wastewater treatment plant improvements took priority	Shift in Timeline	N/A	State	TWDB Project #73785 & #73786
Develop a wastewater reuse program [City of Del Rio]	2030	City of Del Rio	Yes	Not Started	Wastewater treatment plant improvements took priority	Shift in Timeline	N/A	Unknown	
Purchase water from Del Rio Utilities [Laughlin AFB]	2020	Laughlin AFB	Yes	Not Started	Growth Driven	Shift in Timeline	N/A	Unknown	
Water loss audit & main-line repair [Val Verde County-Other | Val Verde County WCID Comstock]	2020	Val Verde County WCID Comstock	Yes	Started	N/A	N/A	N/A	Private	
Water loss audit & main-line repair [Val Verde County-Other | San Pedro Canyon Upper Subdivision]	2020	San Pedro Canyon Upper Subdivision	Yes	Started	N/A	N/A	N/A	Private	
Water loss audit & main-line repair [Val Verde County-Other | Tierra Del Lago]	2020	Tierra Del Lago	Yes	Started	N/A	N/A	N/A	Private	
Additional groundwater wells [Val Verde County Mining]	2020	Val Verde County Mining	Yes	Not Started	Project Sponsor Not Identified	Project Sponsor Not Identified	N/A	Unknown	

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9.2 RWPA'S PROGRESS IN ACHIEVING ECONOMIES OF SCALE

As a result of statutory requirements from HB 807 (86th Legislative Session) the planning rules (31 TAC §357.45(b)) require that each region must include an assessment of the region's efforts to encourage cooperation between WUGs for the purpose of achieving economies of scale and incentivizing WMSs that benefit the entire region. This assessment of regionalization shall include: (1) the number of recommended WMSs in the previously adopted and current RWPs that serve more than one WUG, (2) the number of recommended WMSs in the previously adopted RWP that serve more than one WUG and have been implemented since the previously adopted RWP, and (3) a description of efforts the RWPG has made to encourage WMSs and WMSPs that serve more than one WUG, and that benefit the entire region.

According to the TWDB's data, there are currently no WMSs in the previously adopted and/or current RWP that serve more than one WUG. However, the PWPG recognizes and encourages efforts related to the coordination of developing water management strategies between WUGs where it makes sense. This community-based development is liked by the planning group because it fosters the following key strategies: (1) ensures water solutions are not only practical but also culturally and socially appropriate, (2) embraces the uniqueness of each communities' resources and challenges, advocating for water solutions tailored to specific needs, (3) active community participation instills a sense of ownership and responsibility towards water resources and (4) provides an emphasis on knowledge transfer and helps to empower local communities in becoming good stewards of the water resources.

The PWPG will continue to look for ways to develop shared water management strategies in this *Plan* and for all future regional water plans.

9.3 COMPARISON TO PREVIOUS PLAN

The following section includes a summary that shows how the *2021 Water Plan* differs from the *2026 Water Plan*. Comparisons include:

- Water demand projections.
- Drought of record and the hydrologic and modeling assumptions on which plans are based.
- Water availability at the source.
- Existing water supplies of WUGs.
- WUG and WWP needs.
- Recommended and alternative water management strategies.
- Any other aspects of the plans that the PWPG chooses to compare.

9.3.1 Water Demand Projections

Table 9-2 provides a comparison between *2021* and *2026 Plan* water demand projections by county, while Table 9-3 compares water demand projections by water-use category. The overall increase in water demand in the *2026 Plan* is mostly the result of significantly higher irrigation use projections.

Table 9-2. Water Demand Projections Comparison by County (Ac-ft/yr)

County	Plan	2030	2040	2050	2060	2070	2080
Bandera	2021	4,007	4,330	4,493	4,553	4,601	4,629
	2026	4,627	4,669	4,725	4,782	4,838	4,896
Edwards	2021	1,092	1,082	1,073	1,071	1,071	1,071
	2026	1,037	990	953	930	909	886
Kerr	2021	9,659	9,780	9,827	9,926	10,054	10,166
	2026	14,776	15,268	15,644	16,242	16,847	17,425
Kinney	2021	5,227	5,218	5,204	5,201	5,199	5,199
	2026	8,299	8,227	8,182	8,153	8,126	8,097
Real	2021	881	866	853	848	847	847
	2026	1,091	1,013	951	903	856	807
Val Verde	2021	16,471	17,452	18,394	19,361	20,306	21,243
	2026	21,150	21,188	21,260	21,310	21,360	21,411
Total	**2021**	**37,337**	**38,728**	**39,844**	**40,960**	**42,078**	**43,155**
	2026	**50,980**	**51,355**	**51,715**	**52,320**	**52,936**	**53,522**

Table 9-3. Water Demand Projections Comparison by Water-User Category (Acre-Feet/Year)

Water Use Category	Plan	2030	2040	2050	2060	2070	2080
Municipal	2021	19,340	20,045	20,672	21,380	22,062	22,724
	2026	24,651	24,874	25,081	25,481	25,888	26,272
County-Other	2021	6,635	7,234	7,692	8,134	8,592	9,018
	2026	8,087	8,230	8,372	8,568	8,769	8,962
Manufacturing	2021	20	21	21	21	21	21
	2026	37	38	39	40	41	42
Mining	2021	355	418	448	14	392	380
	2026	312	320	330	338	345	353
Livestock	2021	2,182	2,182	2,182	2,182	2,182	2,182
	2026	2,655	2,655	2,655	2,655	2,655	2,655
Irrigation	2021	8,805	8,805	8,805	8,805	8,805	8,805
	2026	15,238	15,238	15,238	15,238	15,238	15,238

9.3.2 Drought of Record and Hydrologic and Modeling Assumptions

The drought of record consideration for water supply analysis for both the 2021 and *2026 Plans* is the drought of the 1950s. However, the *2026 Plan* does recognize that the current drought conditions, as particularly witnessed in the summer of 2011 and 2022 were having a significant impact on local water supply sources. Surface water availability for both the *2021* and *2026 Plans* is based on Run 3 of the TCEQ WAMs for the five river basins within the Plateau Region.

Groundwater availability in the *2021 and 2026 Plans* is based on the MAG volumes that may be produced on an average annual basis to achieve a DFC as adopted by GMAs (per TWC 36.001). Aquifers recognized in both *Plans* that are not included in the GMA-MAG process are termed “non-relevant” and “other aquifer”. Groundwater availability for these sources is calculated by modeling or standard geohydrologic methods.

9.3.3 Source Water Availability

Total water supply from the source decreased from 196,946 ac-ft/yr in the *2021 Plan* to 194,827 ac-ft/yr in the *2026 Plan*, with groundwater and surface water volumes both decreasing slightly due to changes in the models. A Source Data Comparison table is provided in the Executive summary of this *Plan*.

9.3.4 Existing Water Supplies of WUGs

A WUG Data Comparison Table is provided in the Executive Summary of this *Plan* which compares the *2021 Plan* and *2026 Plan* water supplies available to cities and general water-use categories based on the current infrastructure ability of each to obtain water supplies. These abilities primarily include existing infrastructure, water-rights limitations, and groundwater conservation district permit limitations.

9.3.5 WUG and WWP Needs

Water-supply needs occur when a WUG's projected water demand exceeds its supply availability. Table 9-4 and Table 9-5 compare entities in the *2021 Plan* and *2026 Plan* that are projected to experience a water-supply need at some decade in the next 50-years. The dramatic difference between WUG needs in the two *Plans* is primarily the result of the decreased population and water demand projections shown in the *2026 Plan*. Kinney County does not have any water supply shortages within the *2026 Plan.*

Table 9-4. 2021 WUG and MWP Needs (Ac-ft/yr)

County	WUG/MWP	Source Basin	2020	2030	2040	2050	2060	2070
Bandera	Livestock	Guadalupe	2	2	2	2	2	2
	Livestock	Nueces	3	3	3	3	3	3
	Bandera County FWSD 1	San Antonio	66	83	92	96	99	100
	County-Other | Bandera River Ranch 1	San Antonio	28	39	44	46	48	49
	County-Other | Lake Medina Shores	San Antonio	196	225	239	244	248	251
	County-Other | Medina WSC	San Antonio	35	46	51	53	54	55
	Irrigation	San Antonio	75	75	75	75	75	75
Edwards	Mining	Colorado	12	12	12	12	12	12
	Rocksprings	Nueces	98	96	94	94	94	94
	Mining	Nueces	16	16	16	16	16	16
	Mining	Rio Grande	31	31	31	31	31	31
Kerr	Mining	Colorado	11	12	15	16	17	19
	Livestock	Colorado	119	119	119	119	119	119
	County-Other | Center Point	Guadalupe	3	3	3	3	3	4
	County-Other | Center Point Taylor System	Guadalupe	2	2	3	3	4	5
	Livestock	Guadalupe	173	173	173	173	173	173
	County-Other	Nueces	1	1	1	1	1	1
	Livestock	Nueces	6	6	6	6	6	6
	Livestock	San Antonio	27	27	27	27	27	27
Kinney	Livestock	Nueces	27	27	27	27	27	27
Real	Camp Wood	Nueces	143	139	136	135	135	135
Val Verde	Del Rio Utilities Commission	Rio Grande	4,423	4,918	5,419	5,995	6,598	7,191
	Laughlin Air Force Base	Rio Grande	87	183	284	346	345	345
	County-Other	Rio Grande					12	377
	Mining	Rio Grande	151	210	220	184	153	132

Table 9-5. 2026 WUG and MWP Needs (Ac-ft/yr)

County	WUG/MWP	Source Basin	2030	2040	2050	2060	2070	2080
Bandera	Livestock	Nueces	20	20	20	20	20	20
	Irrigation	San Antonio	157	157	157	157	157	157
Edwards	Rocksprings	Nueces	66	53	42	36	30	23
	Mining	Nueces	8	8	8	8	8	8
	Livestock	Nueces	53	53	53	53	53	53
	Irrigation	Rio Grande	15	15	15	15	15	15
Kerr	County-Other	Colorado	79	83	86	91	96	101
	Livestock	Colorado	28	28	28	28	28	28
	Irrigation	Colorado	97	97	97	97	97	97
	Kerrville	Guadalupe	1,445	1,780	2,032	2,435	2,842	3,231
	Kerrville South Water	Guadalupe	70	88	103	126	150	173
	Mining	Guadalupe	75	75	75	75	75	75
	Livestock	San Antonio	41	41	41	41	41	41
	Irrigation	San Antonio	3	3	3	3	3	3
Real	Camp Wood	Nueces	147	124	106	92	78	64
	Manufacturing	Nueces	2	2	2	2	2	2
Val Verde	Del Rio Utilities	Rio Grande	5,516	5,524	5,556	5,587	5,618	5,649
	Mining	Rio Grande	0	6	15	23	30	38

9.3.6 Recommended Water Management Strategies and Projects

A total of 67 water management strategies (Table 9-6) for 35 WUGs were recommended in the *2021 Plan*, with a total capital cost of $230,456,000. The *2026 Plan* contains a total of 65 recommended and five alternate strategies/projects (Table 9-7) for 33 WUGs with a total capital cost of $515,667,573.

Table 9-6. 2021 Summary of Recommended Water Management Strategies

County	Water User Group	Strategy	Strategy ID	Strategy Supply (Ac-ft/yr)						Total Capital Cost
				2020	2030	2040	2050	2060	2070	
Bandera	City of Bandera	Reuse treated wastewater effluent for irrigation of public spaces	J-1	0	310	310	310	310	310	$1,496,000
		Promote, design & install rainwater harvesting systems on public buildings	J-2	0	1	1	1	1	1	$56,000
		Additional Lower Trinity well and lay necessary pipeline **ALTERNATE**	J-3	0	403	403	403	403	403	$3,298,000
		Additional Middle Trinity wells within City water infrastructure area	J-4	161	161	161	161	161	161	$625,000
		Surface water acquisition, treatment and ASR	J-5	0	1,500	1,500	1,500	1,500	1,500	$34,188,000
	*Bandera County FWSD #1	Public conservation education	J-6	2	2	2	2	2	2	$0
		Additional groundwater well	J-7	100	100	100	100	100	100	$990,000
	*Bandera County Other - Bandera River Ranch #1	Water loss audit and main-line repair for	J-8	4	4	4	4	4	4	$902,000
	*Bandera County Other - Lake Medina Shores	Public conservation education	J-9	3	3	3	3	3	3	$0
		Additional groundwater wells **ALTERNATE**	J-10	251	251	251	251	251	251	$1,477,000
	*Bandera County Other - Medina WSC	Public conservation education	J-11	1	1	1	1	1	1	$0
		Additional groundwater well	J-12	55	55	55	55	55	55	$1,417,000
	Bandera County Other	Drought management (BCRAGD)	J-14	441	491	516	525	533	537	$0
	Bandera County Other - Volunteer Fire Dept.	Additional groundwater wells to provide emergency supply **ALTERNATE**	J-16	189	189	189	189	189	189	$4,280,000
	Bandera County Other - Enchanted River Estates	Water loss audit and main-line repair	J-17	1	1	1	1	1	1	$117,000
	Bandera County Other	Drought management (BCRAGD)	J-18	23	26	27	28	28	28	$0
	*Bandera County Irrigation	Irrigation scheduling	J-20	36	36	36	36	36	36	$0
		Additional groundwater wells	J-21	75	75	75	75	75	75	$291,000

Table 9-6. (continued) 2021 Summary of Recommended Water Management Strategies

County	Water User Group	Strategy	Strategy ID	Strategy Supply (Ac-ft/yr)						Total Capital Cost
				2020	2030	2040	2050	2060	2070	
Bandera	*Bandera County Livestock	Livestock conservation	J-22	1	1	1	1	1	1	$0
		Additional groundwater well	J-23	2	2	2	2	2	2	$135,000
		Livestock conservation	J-24	1	1	1	1	1	1	$0
		Additional groundwater well	J-25	3	3	3	3	3	3	$126,000
Edwards	City of Rocksprings	Public conservation education	J-26	1	1	1	1	1	1	$0
		Additional groundwater well	J-27	121	121	121	121	121	121	$681,000
	Edwards County Other (Barksdale WSC)	Additional well in the Nueces River Alluvium Aquifer and RO wellhead treatment	J-28	54	54	54	54	54	54	$178,000
	*Edwards County Mining	Additional groundwater well	J-31	16	16	16	16	16	16	$125,000
		Additional groundwater well	J-33	12	12	12	12	12	12	$73,000
		Additional groundwater wells	J-35	31	31	31	31	31	31	$132,000
Kerr	*City of Kerrville	Increase wastewater reuse	J-36	2,500	2,500	2,500	2,500	2,500	2,500	$12,570,000
		Water loss audit and main-line repair	J-37	134	134	134	134	134	134	$12,636,000
		Explore and develop new Ellenburger Aquifer well supply	J-39	1,156	1,156	1,156	1,156	1,156	1,156	$14,493,000
		Increased water treatment and ASR capacity	J-41	0	3,360	3,360	3,360	3,360	3,360	$15,393,000
	Kerr County Other - Eastern Kerr County Regional Water Supply Project (EKCRWSP)	Project 1. Construction of an Ellenburger Aquifer water supply well	J-45	0	108	108	108	108	108	$652,000
		Project 2. Construction of off-channel surface water storage		0	1,121	1,121	1,121	1,121	1,121	$25,231,000
		Project 2. Construction of surface water treatment facilities and transmission lines								$22,829,000
		Project 3. Construction of ASR facility		0	1,124	1,124	1,124	1,124	1,124	$1,461,000

Table 9-6. (continued) 2021 Summary of Recommended Water Management Strategies

County	Water User Group	Strategy	Strategy ID	Strategy Supply (Ac-ft/yr)						Total Capital Cost
				2020	2030	2040	2050	2060	2070	
Kerr	Kerr County Other - EKCRWSP	Project 4. Construction of Trinity Aquifer wellfield for dense, rural areas	J-45	0	860	860	860	860	860	$8,367,000
		Project 4. Construction of desalination plant								$21,162,000
	Kerr County Other - *Center Point	Public conservation education	J-54	1	1	1	1	1	1	$0
		Purchase water from EKCRWSP	J-46	11	11	11	11	11	11	$0
	Kerr County Other - *Center Point Taylor System	Public conservation education	J-55	1	1	1	1	1	1	$0
		Purchase water from EKCRWSP	J-47	43	43	43	43	43	43	$0
	Kerr County Other - Verde Park Estates	Water loss audit and main-line repair	J-42	1	1	1	1	1	1	$155,000
	*Kerr County Other	Public conservation education	J-43	1	1	1	1	1	1	$0
	*Kerr County Livestock	Livestock conservation	J-56	24	24	24	24	24	24	$0
		Additional groundwater wells **ALTERNATE**	J-57	119	119	119	119	119	119	$985,000
		Livestock conservation	J-58	35	35	35	35	35	35	$0
		Additional groundwater wells **ALTERNATE**	J-59	173	173	173	173	173	173	$370,000
		Livestock conservation	J-60	5	5	5	5	5	5	$0
		Additional groundwater well **ALTERNATE**	J-61	27	27	27	27	27	27	$79,000
		Livestock conservation	J-62	1	1	1	1	1	1	$0
		Additional groundwater well **ALTERNATE**	J-63	6	6	6	6	6	6	$66,000
	*Kerr County Mining	Additional groundwater wells	J-65	19	19	19	19	19	19	$197,000

Table 9-6. (continued) 2021 Summary of Recommended Water Management Strategies

County	Water User Group	Strategy	Strategy ID	Strategy Supply (Ac-ft/yr)						Total Capital Cost
				2020	2030	2040	2050	2060	2070	
Kinney	City of Brackettville	Increase supply to Spofford with new water line	J-66	0	3	3	3	3	3	$4,271,000
		Increase storage facility	J-67	0	3	3	3	3	3	$1,272,000
	Fort Clark Springs MUD	Water loss audit and main-line repair	J-68	79	79	79	79	79	79	$1,531,000
Kinney	Fort Clark Springs MUD	Increase storage facility	J-69	0	620	620	620	620	620	$1,501,000
Real	*City of Camp Wood	Public conservation education	J-72	1	1	1	1	1	1	$0
		Additional groundwater wells	J-73	143	143	143	143	143	143	$1,709,000
	City of Leakey	Additional groundwater well	J-75	91	91	91	91	91	91	$189,000
		Develop interconnections between wells within the City	J-76	0	81	81	81	81	81	$202,000
	Real County Other - Real WSC	Water loss audit and main-line repair	J-77	2	2	2	2	2	2	$482,000
	Real County Other - Oakmont Saddle Mountain WSC	Additional groundwater well	J-79	54	54	54	54	54	54	$417,000

Table 9-6. (continued) 2021 Summary of Recommended Water Management Strategies

County	Water User Group	Strategy	Strategy ID	Strategy Supply (Ac-ft/yr)						Total Capital Cost
				2020	2030	2040	2050	2060	2070	
Val Verde	*City of Del Rio	Water loss audit and main-line repair	J-80	12	12	12	12	12	12	$5,672,000
		Additional groundwater well	J-81	7,191	7,191	7,191	7,191	7,191	7,191	$12,695,000
		Water treatment plant expansion	J-82	0	943	943	943	943	943	$8,646,000
		Develop a wastewater reuse program	J-83	0	3,092	3,092	3,092	3,092	3,092	$2,846,000
	Laughlin Air Force Base	Purchase water from City of Del Rio	J-87	87	183	284	346	345	345	$0
	Val Verde County Other - Val Verde County WCID Comstock	Water loss audit and main-line repair	J-84	1	1	1	1	1	1	$406,000
	Val Verde County Other - San Pedro Canyon Upper Subdivision	Water loss audit and main-line repair	J-85	7	7	7	7	7	7	$142,000
	Val Verde County Other - Tierra Del Lago	Water loss audit and main-line repair	J-86	4	4	4	4	4	4	$146,000
	*Val Verde County Mining	Additional groundwater wells	J-89	242	242	242	242	242	242	$1,096,000

Table 9-7. 2026 Summary of Recommended Water Management Projects

County	Water User Group	Strategy	Strategy ID	Strategy Supply (Ac-ft/yr)						Total Capital Cost
				2030	2040	2050	2060	2070	2080	
Bandera	City of Bandera	Water loss audit and main-line repair	J-1	5	5	5	5	5	5	$5,327,000
		Reuse treated wastewater effluent for irrigation of public spaces	J-2	0	310	310	310	310	310	$2,117,000
		Promote, design & install rainwater harvesting systems on public buildings	J-3	0	1	1	1	1	1	$83,000
		Additional Lower Trinity well and lay necessary pipeline **ALTERNATE**	J-4	0	403	403	403	403	403	$7,067,000
		Additional Middle Trinity wells within City water infrastructure area	J-5	161	161	161	161	161	161	$1,115,000
		Surface water acquisition, treatment, and ASR	J-6	0	1,500	1,500	1,500	1,500	1,500	$50,501,000
	Bandera County FWSD #1	Public conservation education	J-7	4	4	4	4	4	4	$5,342
		Additional groundwater well	J-8	100	100	100	100	100	100	$1,562,000
	Bandera County-Other (Bridlegate Subdivision)	Water loss audit and main-line repair	J-9	1	1	1	1	1	1	$2,130,000
	Bandera County-Other (Flying L Ranch PUD)	Water loss audit and main-line repair	J-10	2	2	2	2	2	2	$1,065,000
	Bandera County-Other (Medina WSC)	Additional groundwater well	J-11	55	55	55	55	55	55	$2,129,000
	Bandera County-Other (BCRAGD)	Drought management	J-12	441	491	516	525	533	537	$0
	***Bandera County-Other	Vegetative Management	J-13	0	0	0	0	0	0	$0
	Bandera County-Other (Volunteer Fire Dept.)	Additional groundwater wells to provide emergency supply **ALTERNATE**	J-14	189	189	189	189	189	189	$7,527,000
	Bandera County-Other (BCRAGD)	Drought management	J-15	23	26	27	28	28	28	$0
	**Bandera County Irrigation	Irrigation scheduling	J-16	76	76	76	76	76	76	$0
		Additional groundwater wells	J-17	75	75	75	75	75	75	$399,000
	*Bandera County Livestock	Livestock conservation	J-18	13	13	13	13	13	13	$0
		Additional groundwater wells	J-19	8	8	8	8	8	8	$671,000

Table 9-7. (continued) 2026 Summary of Recommended Water Management Projects

County	Water User Group	Strategy	Strategy ID	Strategy Supply (Ac-ft/yr)						Total Capital Cost
				2030	2040	2050	2060	2070	2080	
Edwards	City of Rocksprings	Public conservation education	J-20	2	2	2	2	2	2	$5,555
		Water loss audit and main-line repair	J-21	5	5	5	5	5	5	$2,130,000
		Additional groundwater well	J-22	121	121	121	121	121	121	$1,020,000
	Edwards County-Other (Barksdale WSC)	Additional well in the Nueces River Alluvium Aquifer and RO wellhead treatment	J-23	54	54	54	54	54	54	$317,000
	***Edwards County-Other	Vegetative Management	J-24	0	0	0	0	0	0	$0
	*Edwards County Irrigation	Irrigation Scheduling	J-25	3,806	3,806	3,806	3,806	3,806	3,806	$0
	*Edwards County Livestock	Livestock conservation	J-26	51	51	51	51	51	51	$0
	*Edwards County Mining	Mining Conservation	J-27	2	2	2	2	2	2	$0
		Additional groundwater well	J-28	16	16	16	16	16	16	$154,000
Kerr	*City of Kerrville	Increase wastewater reuse	J-29	2,500	2,500	2,500	2,500	2,500	2,500	$23,355,000
		Water loss audit and main-line repair	J-30	42	42	42	42	42	42	$28,757,000
		Additional groundwater well	J-31	1,156	1,156	1,156	1,156	1,156	1,156	$38,542,000
		Increased water treatment and ASR capacity	J-32	0	3,360	3,360	3,360	3,360	3,360	$21,621,000
	*Kerrville South Water	Additional groundwater wells	J-33	200	200	200	200	200	200	$2,209,000
	Kerr County-Other (EKCRWSP)	Project 1. Construction of an Ellenburger Aquifer water supply well	J-34	0	108	108	108	108	108	$906,000
		Project 2. Construction of off-channel surface water storage		0	1,121	1,121	1,121	1,121	1,121	$39,053,000
		Project 2. Construction of surface water treatment facilities and transmission lines								$48,626,000
		Project 3. Construction of ASR facility		0	1,124	1,124	1,124	1,124	1,124	$1,881,000
		Project 4. Construction of Trinity Aquifer wellfield for dense, rural areas		0	860	860	860	860	860	$13,067,000
		Project 4. Construction of desalination plant								$52,888,000
	Kerr County-Other (Center Point)	Purchase water from EKCRWSP	J-35	11	11	11	11	11	11	$0

Table 9-7. (continued) 2026 Summary of Recommended Water Management Projects

County	Water User Group	Strategy	Strategy ID	Strategy Supply (Ac-ft/yr)						Total Capital Cost
				2030	2040	2050	2060	2070	2080	
Kerr	Kerr County-Other (Center Point Taylor System)	Purchase water from EKCRWSP	J-36	43	43	43	43	43	43	$0
	Kerr County-Other (Community Water Group WSC)	Water loss audit and main-line repair	J-37	1	1	1	1	1	1	$1,065,000
	*Kerr County-Other	Purchase water from EKCRWSP	J-38	102	102	102	102	102	102	$0
	***Kerr County-Other	Vegetative Management	J-39	0	0	0	0	0	0	$0
	*Kerr County Irrigation	Irrigation scheduling	J-40	1,941	1,941	1,941	1,941	1,941	1,941	$0
	*Kerr County Irrigation	Irrigation scheduling	J-41	1,941	1,941	1,941	1,941	1,941	1,941	$0
	*Kerr County Livestock	Livestock conservation	J-42	6	6	6	6	6	6	$0
		Additional groundwater wells **ALTERNATE**	J-43	24	24	24	24	24	24	$318,000
	*Kerr County Livestock	Livestock conservation	J-44	9	9	9	9	9	9	$0
		Additional groundwater wells **ALTERNATE**	J-45	54	54	54	54	54	54	$255,000
	*Kerr County Mining	Mining Conservation	J-46	30	30	30	30	30	30	$0
		Additional groundwater wells **ALTERNATE**	J-47	48	48	48	48	48	48	$360,000
Kinney	City of Brackettville	Increase supply to Spofford with new water line	J-48	0	3	3	3	3	3	$13,196,000
		Increase storage facility	J-49	0	3	3	3	3	3	$1,438,000
	Fort Clark Springs MUD	Increase storage facility	J-50	0	620	620	620	620	620	$2,499,000
	Kinney County Other	Vegetative Management	J-51	0	0	0	0	0	0	$0
	Kinney County Other	Vegetative Management	J-52	0	0	0	0	0	0	$0

Table 9-7. (continued) 2026 Summary of Recommended Water Management Projects

County	Water User Group	Strategy	Strategy ID	Strategy Supply (Ac-ft/yr)						Total Capital Cost
				2030	2040	2050	2060	2070	2080	
Real	*City of Camp Wood	Public conservation education	J-53	1	1	1	1	1	1	$4,697
		Additional groundwater wells	J-54	258	258	258	258	258	258	$2,531,000
	City of Leakey	Public conservation education	J-55	1	1	1	1	1	1	$5,979
		Additional groundwater well	J-56	91	91	91	91	91	91	$646,000
		Develop interconnections between wells within the City	J-57	0	81	81	81	81	81	$791,000
	Real County Other - Real WSC	Water loss audit and main-line repair	J-58	1	1	1	1	1	1	$1,065,000
Real	Real County Other - Oakmont Saddle Mountain WSC	Additional groundwater well	J-59	54	54	54	54	54	54	$615,000
	Real County Other	Vegetative Management	J-60	0	0	0	0	0	0	$0
	**Real County Manufacturing	Manufacturing Conservation	J-61	1	1	1	1	1	1	$0
Val Verde	*City of Del Rio	Water loss audit and main-line repair	J-62	631	631	631	631	631	631	$89,466,000
		Additional groundwater well	J-63	7,191	7,191	7,191	7,191	7,191	7,191	$19,764,000
		Water treatment plant expansion	J-64	0	943	943	943	943	943	$10,489,000
		Develop a wastewater reuse program	J-65	0	3,092	3,092	3,092	3,092	3,092	$11,451,000
	Val Verde County Other - San Pedro Canyon Upper Subdivision	Water loss audit and main-line repair	J-66	3	3	3	3	3	3	$1,065,000
	Val Verde County Other - Tierra Del Lago	Water loss audit and main-line repair	J-67	5	5	5	5	5	5	$1,065,000
	Val Verde County Other	Vegetative Management	J-68	0	0	0	0	0	0	$0
	*Val Verde County Mining	Mining Conservation	J-69	15	16	17	18	19	21	$0
		Additional groundwater wells	J-70	242	242	242	242	242	242	$1,348,000

9.4 PROGRESS OF REGIONALIZATION

Five of the six counties that comprise the Plateau Region are highly rural with each county containing only one or two communities of significant size. Generally, these rural communities are totally self-supportive without need or justification for regional / shared water supply projects.

The *2026 Plateau Region Water Plan* projects only a limited amount of water-supply shortage for the rural Guadalupe River Basin portion of Kerr County at large; however, it is recognized that a greater percentage of the rural population is concentrated in the eastern portion of the county (see Chapter 2, Figure 2-3). Population growth in eastern Kerr County continues to increase, creating genuine concerns pertaining to the water availability needed to meet these growing demands.

To meet this anticipated need, the Kerr County Commissioners' Court (KCCC) in partnership with the UGRA has plans to develop the EKCRWSP to provide for conjunctive use of surface water and groundwater in high density growth areas of eastern Kerr County outside of the area serviced by the City of Kerrville. The EKCRWSP includes both water and wastewater facilities and will draw on several proposed strategies to tap multiple water-supply sources (see Chapter 5, Strategy J-34).

Regionalization thus plays a key role in moving both surface water and groundwater supplies to the numerous end-users in the County. This *2026 Plateau Region Water Plan* continues to support regionalization by recognizing that future water supplies can best be shared in this high-growth community through cooperative management.

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CHAPTER 10

PUBLIC PARTICIPATION AND PLAN ADOPTION

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10 PUBLIC PARTICIPATION AND PLAN ADOPTION

The PWPG members recognized from the beginning the importance of involving the public in the planning process. Chapter 10 contains an overview of the PWPG representation, the Group's commitment to public involvement, rural outreach, administrative planning process, specific activities that insured that the public was informed and involved in the planning process, and the implementation of the *Plan*. Chapter 10 appendices contain comments and responses on the Initially Prepared Plan by the Public (Appendix 10A), TWDB (Appendix 10B), and TPWD (Appendix 10C).

10.1 PLATEAU WATER PLANNING GROUP

The TWDB appointed an initial coordinating body or PWPG for the original Region J based on names submitted by the public for consideration. The PWPG then voted to change its name to Plateau and expanded its membership based on their knowledge of additional persons who could appropriately represent WUGs (Table 10-1). Non-voting members representing interested State agencies and adjacent planning regions are listed in Table 10-2. State planning provisions mandate that one or more representatives of the following WUGs be seated on each planning group: agriculture, counties, electric generating utilities, environment, industries, municipalities, river authorities, public, small business, water districts, and water utilities. An electric generating utility does not exist within the Plateau Region and is therefore not represented. In addition to the other 10 categories, the PWPG chose to appoint a member to represent the tourism industry because of its prevalence in the Region. Also, to ensure adequate geographic representation, the PWPG made sure that at least one member was selected from each of the six counties. Membership was also extended to represent the three Groundwater Management Areas within the Region. Staff persons from both the TPWD and the Texas Department of Agriculture were also appointed as non- voting members.

Table 10-1. Plateau Water Planning Group Voting Members (Effective August 8, 2024)

Water Use Category	Committee Member	County	Entity
Agricultural	Wes Robinson	Kinney	Kinney County
Counties	Vacant	Edwards	Edwards County
Environmental	Tully Shahan	Kinney	Attorney At Law
Industries	Jess Erlund	Kerr	Aqua Texas
Municipalities	Carlos Velarde	Val Verde	Val Verde County
	Vacant	Kerr	City of Kerrville
Other	Jerry Simpton	Val Verde	The Bank and Trust
	Feathergail Wilson	Bandera	Strata Geological Services
Public	Dell Dickinson	Val Verde	Skyline Ranch
	Max Martin	Edwards, Kinney, Val Verde	Martin Ranch Mgmt.
	Brian Leiker	Bandera, Kerr, Real	Real-Edwards Conservation & Reclamation District
River Authorities	Tara Bushnoe	Kerr	UGRA
Small Business	Jonathan Letz (Chair)	Kerr	Kerr County
Tourism	Homer Stevens	Bandera	The Farm Country Club & RV Park
Water Districts	Roland Trees	Real	Real-Edwards Conservation & Reclamation District
	Gene Williams (Secretary)	Kerr	Headwaters Groundwater Conservation District
	David Mauk	Bandera	Bandera County River Authority & Groundwater Conservation District
	Marti Payne	Kinney	Kinney County Groundwater Conservation District
Water Utilities	Charlie Wiedenfeld	Kerr	Wiedenfeld Water Works, Inc.
GMA	Genell Hobbs (Vice Chair)		GMA 7
	David Jeffery		GMA 9
	Genell Hobbs (Vice Chair)		GMA 10

Table 10-2. Plateau Water Planning Group Non-Voting Members (Effective August 8, 2024)

Committee Member	Entity
Lann Bookout	Texas Water Development Board
Carol Faulkenberry	Texas Department of Agriculture
JD Lawrence (Alternate)	
Lindsey Elkins	Texas Parks & Wildlife Department
Sarah Robertson (Alternate)	
Kendria Ray	Texas State Soil & Water Conservation Board
Kenn Norris	Region E Liaison
Paul Tybor	Region K Liaison
Con Mims	Region L Liaison
Tomas Rodriguez	Region M Liaison
Carl Schwing	Region J Liaison to Region M

10.1.1 Interregional Planning Council

The TWDB is required by Texas Water Code Section 16.052 to appoint an Interregional Planning Council made up of one member from each RWPG. The purpose of the Council is to:

- Improve coordination among the RWPGs, and between the RWPGs and the TWDB in meeting goals of the State water planning process.
- Facilitate dialogue regarding regional water management strategies.
- Share operational best practices of the regional water planning process.

The PWPG has appointed Jonathan Letz to this position.

10.1.2 Rural Outreach Efforts

The majority of the Plateau Planning Area encompasses a multitude of rural communities. Engagement with these communities has always been a critical component of regional water planning for the PWPG. Rural outreach has helped to improve data accuracy, promote sustainable practices, build stronger relationships which has increased participation, provide opportunities for learning, better understand the unique needs and priorities of the communities, and help to spread knowledge, connecting people with resources.

This *Plan* is largely supported by information provided by WUGs based on numerous survey results. For example, information needed to report on population and water demand projection revisions were collected through a survey (Section 2.1.1 and 2.1.2). Information needed to report on existing supplies and supply capacity (Chapter 3), infeasible WMSs (Chapter 5), implementation and timing of the WMSs (Chapter 9) and drought information, activities and responses (Chapter 7) are all examples of where rural outreach and engagement were performed for the development of this *Plan.*

Surveys were distributed to all the identified WUGs within the Region. In addition, telephone follow-up calls were conducted to ensure responses from each WUG had been received. The results of these surveys are presented in multiple tables throughout the *Plan.*

10.2 ADMINISTRATIVE PROCESS AND PROJECT MANAGEMENT

The PWPG functions through procedures set forth in their adopted bylaws and follow planning guidelines establish by Legislative rule and TWDB contractual guidelines. With planning funds administered through TWDB, the PWPG then hires technical consultants to perform the work of preparing the regional plan for planning group review and adoption. Work required completing the Plan follows well-defined guidelines intended to meet the mandated legislation and to establish a degree of format uniformity between plans submitted by all 16 planning regions. The PWPG operates its administrative function through the UGRA, which oversees contractual and budgetary obligations. All meetings of the PWPG are open to the public and meet the Texas Open Meetings Act and Public Information Act requirements.

To provide a public access point, an internet website called the Plateau Water Planning Group contains timely information that includes names of planning group members, bylaws, meeting schedules, agendas, minutes, meeting backup materials, and important documents, including groundwater conservation district management plans, technical reports, draft chapters for review, planning schedules and budgets, and links to water-related sites. Summaries of most of the planning group meetings were e-mailed to the full list of interested parties, to enable persons who were unable to attend to stay up to date on the planning process. Every document that was e-mailed or mailed to Planning Group Members for their review was also e-mailed to the interested parties list, made available on the PWPG website, and provided in hard copy at all public meetings. In addition, news stories concerning water planning-related issues were regularly distributed to all interested parties.

10.3 PLANNING GROUP MEETINGS AND PUBLIC HEARINGS

All activities associated with the Regional Water Planning Process were performed in accordance with the State Open Meetings Act. All meetings of the PWPG, including committee meetings, are open to the public where visitors are afforded the opportunity and encouraged to voice their opinions, concerns, or suggestions. Meetings are primarily held in Kerrville Texas. Meeting notices are posted with the County Commissioners' Courts of each county.

All material to be presented at public meetings and all draft and final *Plan* documents were made available for public inspection on the Planning Group's website hosted by the UGRA in accordance with the Texas Public Information Act.

A public hearing was held on February 20, 2025, to receive comments on the *2026 Initially Prepared Plan*. Notice of the Public Hearings was sent to 334 down-river water rights holders as well as to each county commissioner's court and designated libraries. A hard copy of the *Initially Prepared Plan* was provided to UGRA, made available at the front desk. An electronic copy was made available on the UGRA website. In addition, electronic copies were made available in the courthouse and a designated library in each of the Regions' six counties listed below.

- Bandera County Library.
- Butt-Holdsworth Memorial Library (Kerr County).
- Claud H. Gilmer Memorial Library (Edwards County).
- Kinney County Public Library.
- Real County Public Library.
- Val Verde County Library.

Prior to receiving official comments during the public hearing, a question and answer session was held so that the public attendees would have an opportunity to gain a better understanding of how the draft *Plan* was formulated. At the conclusion of the hearing, the public was notified that there would be a 60-day period in which the PWPG would continue to receive written comments. The TWDB and TPWD also reviewed the *Initially Prepared Plan* and provided comments. Responses to agency and public comments are provided in Appendix 10A, Appendix 10B and Appendix 10C. On X, the PWPG met in a public forum and approved the final *2026 Plateau Region Water Plan* for submittal to the TWDB.

10.4 COORDINATION WITH OTHER REGIONS

Coordination with other regions was accomplished through liaisons shared with adjacent regions (Regions E, F, K, L and M) and through active participation in Chairs Conferences scheduled by the TWDB.

10.5 PLAN IMPLEMENTATION

Following final adoption of the *2026 Plateau Region Water Plan*, copies of the *Plan* were provided to each municipality and county commissioners' court in the Region. An electronic copy of the *Plan* is also available on the UGRA and TWDB websites.

APPENDIX 10A
RESPONSE TO PUBLIC COMMENTS

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PUBLIC COMMENTS

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RESPONSES TO PUBLIC COMMENTS

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APPENDIX 10B
RESPONSE TO TWDB COMMENTS

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RESPONSE TO TWDB COMMENTS

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APPENDIX 10C
RESPONSE TO TPWD COMMENTS

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RESPONSES TO TPWD COMMENTS

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