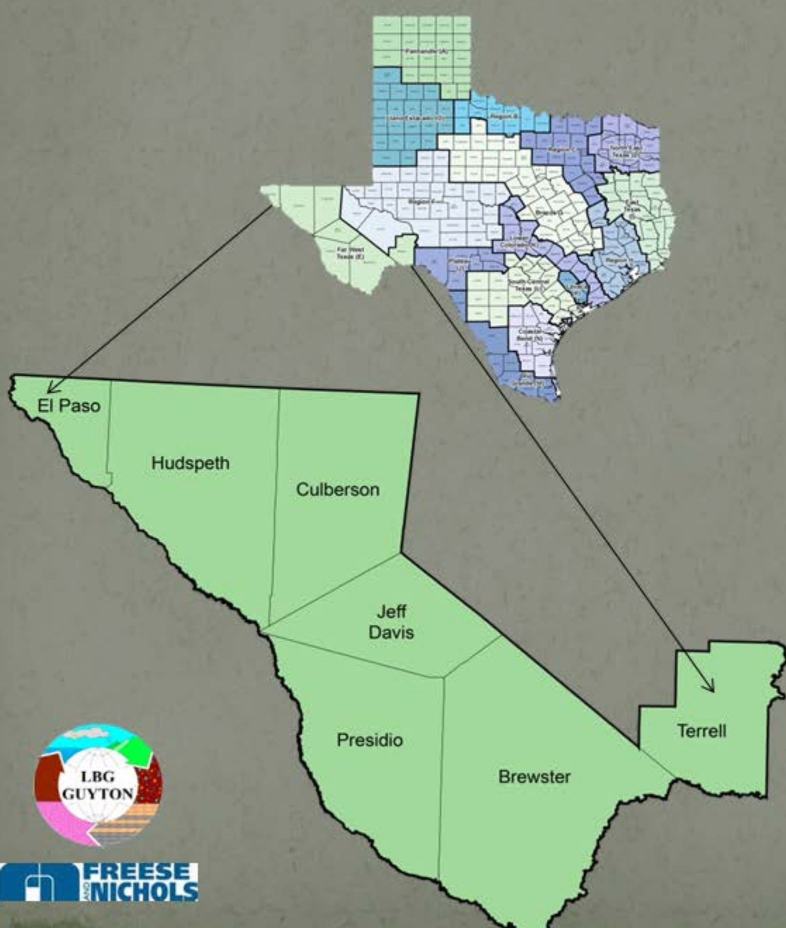
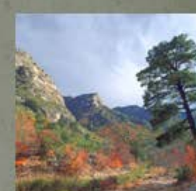
Far West Texas Water Plan

January 2016

Prepared By Far West Texas Water Planning Group

Prepared For Texas Water Development Board





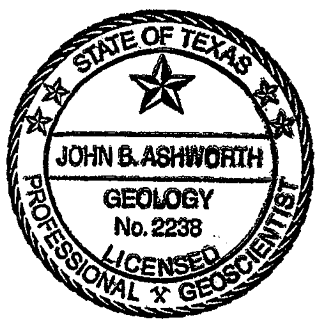
This page intentionally left blank.

2016 Far West Texas Water Plan

Prepared for

Far West Texas Water Planning Group

Prepared by



Jennifer Herrera
Environmental Scientist
LBG-Guyton Associates

John B. Ashworth, P.G.
Senior Consultant
LBG-Guyton Associates

Jon S. Albright
Hydrologist
Freese and Nichols, Inc.

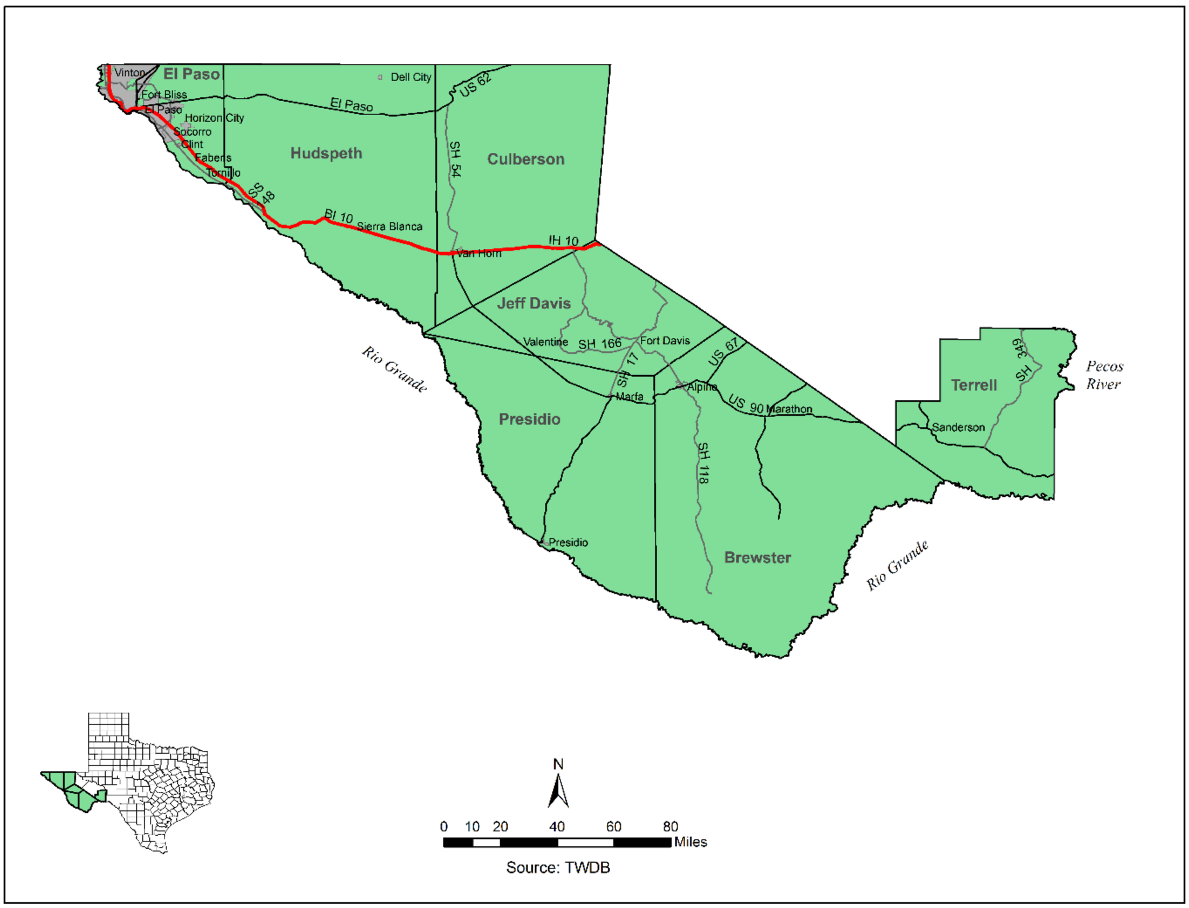
This page intentionally left blank.

EXECUTIVE SUMMARY

Far West Texas encompasses the most arid region of the State of Texas. Residents of this expansive desert environment recognize that water is a scarce and valuable resource that must be developed and managed with great care to ensure the area's long-term viability. The Region's economic health and quality of life are dependent on a sustainable water supply that is equitably managed.

Far West Texas is bounded on the north by New Mexico, on the south and west by the Rio Grande and the United Mexican States, and on the east by the Pecos River and incorporates the counties of Brewster, Culberson, El Paso, Hudspeth, Jeff Davis, Presidio and Terrell, all which lie solely within the Rio Grande River Basin. These counties claim some of the most impressive topography and scenic beauty in Texas. The Region is home to the Guadalupe Mountains National Park, Big Bend National Park, and the contiguous Big Bend Ranch State Park. El Paso, the largest city in the Region, is also the nation's largest city on the U.S.-Mexico border. Ciudad Juarez, with an estimated population of over 1.5 million, is located across the Rio Grande from El Paso, and shares the same water sources with El Paso.

Figure ES-1. Far West Texas Region Water Planning Area Map



In January of 2011, the third round of regional water planning was concluded with the adoption of the *2011 Far West Texas Water 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 current *2016 Far West Texas Water Plan* put forth in this document is not a new plan, but rather an evolutionary modification of the predecessor *Plan*. Only those parts of the original *Plan* that require updating, and there are many, have been revised.

The purpose of the *2016 Far West Texas 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 inform all citizens of the importance of properly managing and conserving the delicate water resources of this desert community.

The *2016 Far West Texas 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 *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.

POPULATION AND WATER DEMAND

With the exception of El Paso County, the counties of Far West Texas are among the least populated in the State. In the year 2020, approximately 97 percent (925,565) of the Region's 954,035 residents are projected to reside in El Paso County, where the population density is 914 persons per square mile. The population density of the six rural counties is 1.2 persons per square mile. Approximately 75 percent of the residents in the Region are Hispanic or Latinos.

El Paso, one of the fastest growing cities in Texas, is the largest city in the Region, with a year-2020 projected population of 734,031. This is 79 percent of the total population of El Paso County and 77 percent of the Region's total population.

The year-2020 projected populations of cities in the six rural counties are as follows: Alpine, Brewster County (6,066); Van Horn, Culberson County (2,319); Sierra Blanca, Hudspeth County (620); Fort Davis, Jeff Davis County (1,264); Marfa, Presidio County (2,203); Presidio, Presidio County (4,867); and Sanderson, Terrell County (889). Population of smaller communities such as Fort Hancock, Dell City, Marathon and Valentine are included in the "County Other" (rural) population of each county. The "County Other" rural population of the Region is 48,664, or five percent of the total rural population.

The regional population is projected to increase to 1,551,438 by the year 2070, which is an increase of 597,403 citizens. Most of this increase (563,305) is projected to occur in El Paso County.

Total projected year-2020 water consumptive use in Far West Texas is 645,404 acre-feet. The largest category of use is irrigation (471,439 acre-feet), followed by municipalities and county-other (141,818 acre-feet), manufacturing (16,144 acre-feet), steam-electric cooling (6,937 acre-feet), mining (6,069 acre-feet), and livestock (2,997 acre-feet). Seventy-three percent of water use in the Region is by the agricultural sector in support of irrigation. Twenty-two percent is used by municipalities and the remaining 5 percent supports manufacturing, steam-electric generation, livestock and mining.

The potential role of conservation is an important factor in projecting future water supply requirements. In this *2016 Plan*, conservation is only 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 strategies and as a component of drought management plans.

Environmental and recreational water use in Far West Texas 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 and mining.

Rural communities (outside of El Paso County) are relatively small and are generally reliant on self-provided water supplies. Water demand within these communities is related directly to their population trends and is thus relatively stable or moderately increasing over the next 50 years. Projected water-demand growth for the numerous communities within El Paso County is significantly greater and thus will require a level of coordinated intercommunity planning.

Water used for agricultural irrigation in Far West Texas is significantly greater (73 percent of total) than all other water-use categories. On a regional basis, water used for the irrigation of crops is projected to decline slightly 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.

Ciudad Juarez is located across the Rio Grande from El Paso, and currently is 100 percent dependent on the Hueco Bolson and Conejos Medanos Aquifers to satisfy all of its municipal and industrial demands. With a growing population that is currently estimated to be over 1.5 million, Ciudad Juarez recognizes the limitations of the Hueco Bolson to supply future demands. In addition, plans are being developed to convert 38,000 acre-feet/year of surface water from the Rio Grande (Rio Bravo) for municipal supply use. Currently, Mexico's allocation from the Rio Grande Project of 60,000 acre-feet/year is used for irrigated agriculture. The conversion would involve supplying wastewater effluent to farmers in exchange for surface water.

WATER SUPPLY RESOURCES

Whether it flows in rivers and streams or percolates through underground rock formations, water sustains life and thus is our most important natural resource. In the Chihuahuan Desert environment of Far West Texas, water supply availability takes on a more significant meaning than elsewhere in the State. With evaporation far exceeding rainfall, planning for the most efficient management of limited water supplies is essential.

Water supply availability from each recognized source is estimated during drought-of record conditions. This allows each entity and water-use category to observe conditions when their supply source is at its most critical availability level. Specific assumptions used in estimating supply availability are listed below:

- With the exception of the controlled flows in the Rio Grande, very little surface water can be considered as a reliable source of supply in Far West Texas, especially in drought-of-record conditions. Two primary surface water sources are considered, the Rio Grande and the Pecos River. Other ephemeral creeks and springs are recognized as important livestock supply, wildlife habitat, and recreational resources.
- The availability of water in the Rio Grande and Pecos River to meet existing permits during drought-of-record conditions is determined by using the TCEQ Rio Grande Water Availability Model (WAM) – Run 3.
- The availability of groundwater is based on TWDB provided Modeled Available Groundwater (MAG) as developed through the Groundwater Management Area process. For aquifers that MAG volumes have not been assigned, groundwater availability estimates are calculated seperately. Also included are groundwater supplies that are made available by the desalination of brackish groundwater sources.
- Reuse of water is calculated for the City of El Paso based on supplies produced and distributed through their “purple pipe” project. Additional reuse supplies will be developed in the future through El Paso’s “purified water” treatment projects.

The Rio Grande originates in southwestern Colorado and northern New Mexico, where it derives its headwaters from snowmelt in the Rocky Mountains. The Elephant Butte Dam and Reservoir in New Mexico is approximately 125 miles north of El Paso and can store over two million acre-feet of water. Water in the reservoir is stored to meet irrigation demands in the Rincon, Mesilla, El Paso, and Juarez Valleys and is released in a pattern for power generation. Above El Paso, flow in the River is largely controlled by releases from Caballo Reservoir located below Elephant Butte; while downstream from El Paso to Fort Quitman, flow consists of treated municipal wastewater from El Paso, untreated municipal wastewater from Juarez, and irrigation return flow. Below the El Paso-Hudspeth County line, flow consists mostly of return flow and occasional floodwater and runoff from adjacent areas. Channel losses are significant enough that the Rio Grande is often dry from below Fort Quitman to the confluence with the Mexican river, the Rio Conchos, upstream of Presidio. There are no significant perennial tributaries, other than the Rio Conchos, in the 350 miles between Elephant Butte Reservoir and Presidio.

The Rio Grande is unique in its complexity of distribution management. Because the waters of the River must be shared between three U.S. states and Mexico, a system of federal, state and local programs has been developed to oversee the equitable distribution of water. Compacts, treaties and projects currently provide the River's management framework.

The Pecos River is the largest Texas river basin that flows into the Rio Grande. Originating in New Mexico, the Pecos flows southerly into Texas, and discharges into the channel of the Rio Grande near Langtry in Val Verde County. The River forms the easternmost border of Far West Texas along the northeast corner of Terrell County. Flows of the Pecos River are controlled by releases from the Red Bluff Reservoir near the Texas - New Mexico state line. Storage in the reservoir is affected by the delivery of water from New Mexico. According to data of the IBWC, the Pecos River contributes an average of 11 percent of the annual streamflow into the Rio Grande near Amistad Reservoir. The Pecos also contributes more than 29 percent of the annual salt loading into the reservoir.

Other than irrigation use and a portion of City of El Paso municipal use from the Rio Grande, almost all other water use in Far West Texas is supplied from groundwater sources. Although not as large in areal extent as some aquifers in the State, individual aquifers in Far West Texas are more numerous (13 TWDB designated and 4 local) than in any of the other planning regions.

El Paso has nearly 50 miles of reclaimed water lines (purple pipeline) in place in all areas of the City. Reclaimed water serves the landscape irrigation demand of golf courses, parks, schools, and cemeteries, and also provides water supplies for steam electric plants and industries within the City. Currently EPWU is operating three reuse projects that provide 6,000 acre-feet per year. This *Plan* explores the potential of a significant increase in reuse of existing supplies by evaluating strategies of advanced treatment to produce purified water that meets state drinking water standards.

Springs and seeps are found in all seven of the Far West Texas counties and have played an important role in the development of the Region. Springs were important sources of water for Native Americans, as indicated by the artifacts and petroglyphs found in the vicinity of many of the springs. In the 18th and 19th centuries, locations of transportation routes including supply and stage coach lines, military outposts, railroads, and early settlements and ranches were largely determined by the occurrence of springs that issued from locations in the mountains and along mountain fronts.

Springs contribute to the aesthetic and recreational value of private land and parkland in Far West Texas - especially in the Big Bend area, where a number of thermal springs discharge along the banks of the Rio Grande. Springs are significant sources of water for both aquatic and terrestrial wildlife as they form small wetlands that attract migratory birds and other fowl that inhabit the Region throughout the year. As documented by the Texas Parks and Wildlife Department, springs also provide habitat for threatened and endangered species of fish (such as the Pecos and Big Bend Gambusia).

The FWTWPG recognizes the importance of all springs in this desert community for their contribution as a water supply source and as a natural habitat. However, the FWTWPG chooses to respect the privacy of private lands and therefore specifically identifies "Major Springs" occurring only on state, federal, or privately owned conservation managed lands.

WATER MANAGEMENT STRATEGIES

Projected water supply deficits in Far West Texas during the next 50 years are identified where anticipated water demands exceed available supplies. Available supplies represent the largest amount of water that can be diverted or pumped from a given source without violating the most restrictive physical, regulatory, or policy condition limiting use, under drought-of-record conditions. Water supply deficits are identified for a number of municipalities, manufacturing use, and steam power electric generation in El Paso County, for irrigation supply use in El Paso and Hudspeth Counties, and for mining supply in Culberson and Terrell Counties.

Water supply strategy recommendations intended to meet the deficits are made for those water use groups that have projected water supply shortages. In addition, strategies have been developed for entities that have expressed a desire for planned projects for which funding applications have been or will be made in the near future to be included in the *Plan*. In the development of water management strategies, existing water rights, water contracts, and option agreements are recognized and fully protected.

A strategy evaluation procedure was designed to provide a side-by-side comparison such that all the strategies could be assessed based on the same factors. Specific factors considered were:

- Quantity of water supply generated
- Water quality considerations
- Reliability
- Cost (total capital cost, annual cost, and cost per acre-foot)
- Environmental impacts
- Impacts to agricultural and natural resources

To adequately consider the unique challenges faced by municipal and industrial water users in El Paso County, a conjunctive approach was used to establish feasible strategies capable of identifying sufficient future supplies to meet the needs of El Paso Water Utilities, the largest wholesale water provider in the county. The following planned projects are to be managed conjunctively to produce a mixed total distributed supply:

- Increased conservation
- Increased reclaimed water treated to purified drinking water standards
- Recharge of groundwater with excess treated surface water
- Expansion of Kay Bailey Hutchison Desalination Plant
- Desalination of agricultural drain water
- Increased surface water use by expansion of Jonathan Rogers WTP
- Expansion of existing groundwater wellfields
- Development of two new groundwater wellfields
- Importation of groundwater from the Capitan Reef Aquifer (Culberson and Hudspeth Counties)

- Importation of groundwater from the Bone Spring-Victorio Peak Aquifer in the Dell City area (Hudspeth County)
- Construction of a facility to capture urban stormwater and excess flows of the Rio Grande

Recommended strategies for other entities in El Paso County include purchasing needed supplies from El Paso Water Utilities or developing needed self-supplied groundwater by drilling additional wells and expanding desalination facilities.

Irrigation shortages in El Paso and Hudspeth Counties are the direct result of insufficient water in the Rio Grande during drought-of-record periods to meet anticipated needs. The quantity of water needed to meet the full demands cannot be realistically achieved and farmers in these areas have generally approached this situation by reducing irrigated acreage, 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 Best Management Practices (BMPs) for agricultural water users, 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. However, a local study of these practices found that very limited opportunities exist for significant additional water conservation in Far West Texas irrigated agriculture. Those practices that suggest economic efficient additional water conservation included lining or pipelining district canals and the very small potential for additional irrigation scheduling and tail water recovery systems. In nearly all cases, these practices have been adapted to a large extent if applicable, further emphasizing the very limited opportunities for additional conservation. If all of these strategies were implemented, the water conserved would satisfy less than 25 percent of the projected unmet agricultural water demand in 2070 during drought-of-record conditions. Based on this evaluation, the FWTWPG recommends irrigation scheduling, tail-water reuse, and improvements to water district delivery systems strategies to attempt to meet the estimated irrigation needs in El Paso and Hudspeth Counties.

The water-needs analysis for all municipalities does not project shortages for any of the communities within the rural counties. However, it is apparent that a number of the communities have water issues that are appropriate for listing in this *Regional Plan*. Therefore, strategies have been evaluated and presented that will hopefully provide incentive for the future development of water resources to address these issues. The *2016 Far West Texas Water Plan* contains a total of 64 recommended water management strategies and one alternative strategy with a total estimated capital cost for develop of $1,903,771,872.

WATER QUALITY

Water quality plays an important role in determining the availability of water supplies to meet current and future water needs in the Region. The quality of groundwater and surface water is evaluated to help determine the suitability of each source for use and the potential impacts on these sources that might result from the implementation of recommended water management strategies.

Groundwater quality issues in the Region 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. Some aquifers, however, have a low TDS but may contain individual constituent levels that exceed safe drinking-water standards. For example, some wells in the Igneous Aquifer have exceptionally low TDS but contain unsatisfactory levels of fluoride.

Groundwater quality changes are often the result of man's activities. In agricultural areas, aquifers such as the Bone Spring-Victorio Peak have increased in TDS. Irrigation water applied on the fields percolates back to the aquifer carrying salts leached from the soil. Beneath El Paso and Ciudad Juarez, the average concentration of dissolved solids in the Hueco Bolson Aquifer has increased as the fresher water in the aquifer is being consumed. Although local instances of groundwater quality degradation have occurred in the Region, there are no major trends that suggest a widespread water-quality problem due to the downward percolation of surface contaminants.

The Rio Grande and the Pecos River are the principal surface water sources in Far West Texas. Unlike groundwater, surface water quality can vary significantly depending on the amount of flow in the streambed and the rate and source of runoff from adjacent lands. Salinity is an issue associated with the Rio Grande, especially during drought conditions. River flows arriving at El Paso contain a substantial salinity contribution from irrigation return flow and municipal wastewater return in New Mexico. Under current conditions, approximately 25 percent of the applied irrigation water is needed to move through the project in El Paso County to keep the salt loading at reasonable and manageable levels given average surface flow rates. Studies have shown that salinities in the Rio Grande can increase to over 1,000 mg/l during May and September, depending on actual irrigation demands and releases from reservoirs.

Downstream from El Paso, most of the flow consists of irrigation return flow, and small amounts of treated and untreated municipal wastewater. Heavy metals and pesticides have been identified along this segment of the Rio Grande. Flow is intermittent downstream to Presidio, where the Rio Conchos augments flow. Fresh water springs contribute to the Rio Grande flow in the Big Bend and enhance the overall quality of the River through this reach.

The Pecos River is not a source of drinking water for communities in Far West Texas; however, it is the most prominent tributary to the Rio Grande on the Texas side of the River above Amistad Reservoir. According to IBWC data, the Pecos River contributes an average of 11 percent of the annual stream flow in the Rio Grande above the Reservoir and 29 percent of the annual salt load. Independence Creek's contribution in Terrell County increases the Pecos River water volume by 42 percent at the confluence and significantly reduces the total suspended solids, thus improving both water quantity and quality.

WATER CONSERVATION AND DROUGHT CONTINGENCY

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, or improve the efficiency in the use of water. Recycling or reuse of water is also a creative method of managing water so that it can be used more than once or for alternative uses. Water conservation and drought contingency planning implemented by municipalities, water providers, and other water users supersede recommendations in this *Plan* and are considered consistent with this *Plan*. Texas Water Code §11.1271 requires water conservation plans for all municipal and industrial water users with surface water rights of 1,000 acre-feet per year or more and irrigation water users with surface water rights of 10,000 acre-feet per year or more.

El Paso Water Utilities is the largest supplier of municipal water in Far West Texas, supplying over 80 percent of the 2020 projected municipal needs in the Region. The City of El Paso through the El Paso Water Utilities has been implementing an aggressive water conservation program and has reduced the per capita demand from 200 gpcd in 1990 to 135 gpcd in 2014. The continuation of the conservation effort is a key component of the El Paso Integrated Water Management Strategy.

Drought is a frequent and inevitable factor in the climate of Texas. Therefore, it is vital to plan for the effect that droughts will have on the use, allocation and conservation of water in the State. Far West Texas is perennially under drought or near-drought conditions compared with more humid areas of the State. Although residents of the Region are generally accustomed to these conditions, the 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. In the consideration of regional conservation and drought management issues, the FWTWPG reviewed active water conservation and drought management plans provided to the planning group by public water suppliers and irrigation districts.

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. Six districts are currently in operation within Far West Texas.

- Brewster County Groundwater Conservation District
- Culberson County Groundwater Conservation District
- Hudspeth County Underground Water Conservation District No.1
- Jeff Davis County Underground Water Conservation District
- Presidio County Underground Water Conservation District
- Terrell County Groundwater Conservation District

PROTECTION OF WATER, AGRICULTURAL, AND NATURAL RESOURCES

The long-term protection of the Region's water, agricultural, and natural resources, and the environment is an important component of this *2016 Far West Texas Water Plan*. The first step in achieving long-term water resources protection was in the process of estimating each source's availability. Surface water estimates were developed through a water availability model process (WAM) and are based on the quantity of surface water available to meet existing water rights during a drought-of-record. The availability of groundwater is based on TWDB provided Modeled Available Groundwater (MAG) as developed through the Groundwater Management Area process. For aquifers that MAG volumes have not been assigned, groundwater availability is based on previous geohydrologic studies, groundwater data including historical use contained in state and federal databases and groundwater availability models (GAMs). Also included are groundwater supplies that are made available by the desalination of brackish groundwater sources. Establishing conservative levels of water source availability thus results in less potential of overexploiting the supply.

The next step in establishing the long-term protection of water resources occurs in the water management strategies 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. Water conservation strategies are also recommended for each entity with a supply deficit. When enacted, the conservation practices will diminish water demand and thus extend supplies over the stress period.

Agriculture includes the raising of crops and livestock, as well as a multitude of businesses that support this industry. Water is an absolute necessity to maintaining this industry and its use represents over three-fourths of all the water used in the Region. It is thus important to the economic health and way of life in the Region to protect water resources that have historically been used in the support of agricultural activities. The *2016 Far West Texas Water Plan* provides irrigation strategy recommendations that address water conservation management practices. If implemented, these practices will result in reduced water application per acre irrigated and diminished water losses due to canal leakage. All non-agricultural recommended water management strategies include an analysis of potential impact to agricultural interests. Any strategy that necessitates the conversion of water use from agricultural practices is voluntary at the current water right and landowner's discretion.

The FWTWPG has adopted a stance toward the protection of natural resources. The protection is closely linked with the protection of water resources as discussed 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. 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. The FWTWPG has also recommended a number of "Ecologically Unique River and Stream Segments".

RECOMMENDATIONS

An important aspect of the regional water planning process is the opportunity to provide recommendations for the improvement of future water management planning in Texas. The recommendations 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. The FWTWPG approves of the legislative intent of the regional water planning process and supports the continuance of water planning at the regional level. However, the FWTWPG suggests that the Legislature and TWDB consider the following issues in the regional water planning process.

- Re-emphasis of the planning function of the regional water planning group and need for more local planning initiatives
- Wastewater and stormwater planning
- Eliminate the unfunded mandate
- Modification of demand numbers
- Needed funding for data collection in rural areas
- Open records exception for private water data
- Plan implementation
- State mandated water planning
- Regional planning cycles
- GMA cycles
- Colonias
- Data needs

As a part of the planning process, each regional planning group may include <u>recommendations</u> for the designation of ecologically unique river and stream segments in their adopted regional water plan. The Texas Legislature may <u>designate</u> a river or stream segment of unique ecological value following the recommendations of a regional water planning group. As per §16.051(f) of the Texas Water Code, this designation solely means 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 segment designated by the legislature under this subsection. The Far West Texas Water Planning Group intends that no negative impact is to occur to upstream landowners as a result of these designations.

The FWTWPG chooses to respect the privacy of private lands and therefore recommends as "Ecologically Unique River and Stream Segments" the following three streams that lie within the boundaries of state-managed properties, four within National Park boundaries, and specified streams managed by the Texas Nature Conservancy and the Trans Pecos Water Trust. New to this *2016 Plan* is the recommendation of a segment of Terlingua Creek in Brewster County that is within the boundaries of the Big Bend National Park.

- Rio Grande Wild and Scenic River (Big Bend National Park)
- McKittrick Canyon and Choza Creek (Guadalupe Mountains National Park)
- Cienega Creek (Chinati Mountains State Natural Area)
- Alamito and Cienega Creeks (Big Bend Ranch State Park)
- Alamito Creek (Trans Pecos Water Trust)
- Independence Creek (Texas Nature Conservancy - Independence Creek Preserve)
- Madera Creek, Canyon Headwaters of Limpia Creek, Little Aguja Creek, and Upper Cherry Creek (Texas Nature Conservancy - Davis Mountains Preserve)
- Terlingua Creek (Big Bend National Park)

The firm yield for any reservoirs constructed on even the most reliable Far West Texas watercourses is not likely to exceed 2,000 acre-feet per year. For this reason, the *2016 Far West Texas Water Plan* does not recommend any watercourse for designation as “Unique Sites for Reservoir Construction.”

This page intentionally left blank.

ES – APPENDIX A

TWDB GENERATED PLANNING DATA TABLES

This page intentionally left blank.

Source Availability

REGION E

GROUNDWATER	COUNTY	BASIN	SALINITY	SOURCE AVAILABILITY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
BONE SPRING-VICTORIO PEAK AQUIFER	HUDSPETH	RIO GRANDE	FRESH/BRACKISH	101,429	101,429	101,429	101,429	101,429	101,429
CAPITAN REEF COMPLEX AQUIFER	BREWSTER	RIO GRANDE	FRESH/BRACKISH	2,100	2,100	2,100	2,100	2,100	2,100
CAPITAN REEF COMPLEX AQUIFER	CULBERSON	RIO GRANDE	FRESH/BRACKISH	7,580	7,580	7,580	7,580	7,580	7,580
CAPITAN REEF COMPLEX AQUIFER | NON-RELEVANT	HUDSPETH	RIO GRANDE	FRESH/BRACKISH	5,100	5,100	5,100	5,100	5,100	5,100
EDWARDS-TRINITY-PLATEAU AQUIFER	BREWSTER	RIO GRANDE	FRESH/BRACKISH	1,394	1,394	1,394	1,394	1,394	1,394
EDWARDS-TRINITY-PLATEAU AQUIFER	CULBERSON	RIO GRANDE	FRESH	2,154	2,154	2,154	2,154	2,154	2,154
EDWARDS-TRINITY-PLATEAU AQUIFER	TERRELL	RIO GRANDE	FRESH	1,421	1,421	1,421	1,421	1,421	1,421
EDWARDS-TRINITY-PLATEAU AQUIFER | NON-RELEVANT	JEFF DAVIS	RIO GRANDE	FRESH	9,288	9,288	9,288	9,288	9,288	9,288
HUECO-MESILLA BOLSON AQUIFER	EL PASO	RIO GRANDE	FRESH/BRACKISH	480,000	480,000	480,000	480,000	480,000	480,000
HUECO-MESILLA BOLSON AQUIFER	HUDSPETH	RIO GRANDE	FRESH/BRACKISH	16,000	16,000	16,000	16,000	16,000	16,000
IGNEOUS AQUIFER	BREWSTER	RIO GRANDE	FRESH	2,586	2,586	2,585	2,583	2,581	2,581
IGNEOUS AQUIFER	CULBERSON	RIO GRANDE	FRESH	99	99	99	99	99	99
IGNEOUS AQUIFER	JEFF DAVIS	RIO GRANDE	FRESH	4,584	4,584	4,584	4,584	4,584	4,584
IGNEOUS AQUIFER	PRESIDIO	RIO GRANDE	FRESH	4,064	4,064	4,064	4,063	4,063	4,063
MARATHON AQUIFER	BREWSTER	RIO GRANDE	FRESH	7,327	7,327	7,327	7,327	7,327	7,327
OTHER AQUIFER | BALMORHEA ALLUVIUM	JEFF DAVIS	RIO GRANDE	FRESH	500	500	500	500	500	500
OTHER AQUIFER | BREWSTER CRETACEOUS	BREWSTER	RIO GRANDE	FRESH	2,800	2,800	2,800	2,800	2,800	2,800
OTHER AQUIFER | DIABLO PLATEAU	HUDSPETH	RIO GRANDE	FRESH	26,400	26,400	26,400	26,400	26,400	26,400
OTHER AQUIFER | PRESIDIO CRETACEOUS	PRESIDIO	RIO GRANDE	FRESH	1,000	1,000	1,000	1,000	1,000	1,000
OTHER AQUIFER | RIO GRANDE ALLUVIUM	EL PASO	RIO GRANDE	BRACKISH	130,380	130,380	130,380	130,380	130,380	130,380
OTHER AQUIFER | RIO GRANDE ALLUVIUM	HUDSPETH	RIO GRANDE	BRACKISH	15,000	15,000	15,000	15,000	15,000	15,000
RUSTLER AQUIFER	BREWSTER	RIO GRANDE	BRACKISH/SALINE	0	0	0	0	0	0
RUSTLER AQUIFER	CULBERSON	RIO GRANDE	BRACKISH/SALINE	1,000	1,000	1,000	1,000	1,000	1,000
WEST TEXAS BOLSONS AQUIFER | EAGLE FLAT	HUDSPETH	RIO GRANDE	FRESH/BRACKISH	2,869	2,869	2,869	2,869	2,869	2,869
WEST TEXAS BOLSONS AQUIFER | GREEN RIVER VALLEY	HUDSPETH	RIO GRANDE	FRESH/BRACKISH	82	82	82	82	82	82
WEST TEXAS BOLSONS AQUIFER | GREEN RIVER VALLEY	JEFF DAVIS	RIO GRANDE	FRESH/BRACKISH	82	82	82	82	82	82
WEST TEXAS BOLSONS AQUIFER | GREEN RIVER VALLEY	PRESIDIO	RIO GRANDE	FRESH/BRACKISH	82	82	82	82	82	82

Source Availability

REGION E

GROUNDWATER	COUNTY	BASIN	SALINITY	SOURCE AVAILABILITY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
WEST TEXAS BOLSONS AQUIFER | PRESIDIO-REDFORD	PRESIDIO	RIO GRANDE	FRESH/BRACKISH	6,282	6,282	6,282	6,282	6,282	6,282
WEST TEXAS BOLSONS AQUIFER | RED LIGHT DRAW	HUDSPETH	RIO GRANDE	FRESH/BRACKISH	1,631	1,631	1,631	1,631	1,631	1,631
WEST TEXAS BOLSONS AQUIFER | SALT BASIN	CULBERSON	RIO GRANDE	FRESH/BRACKISH	35,749	35,678	35,601	35,550	35,509	35,509
WEST TEXAS BOLSONS AQUIFER | SALT BASIN	JEFF DAVIS	RIO GRANDE	FRESH/BRACKISH	6,055	6,055	5,989	5,960	5,942	5,942
WEST TEXAS BOLSONS AQUIFER | SALT BASIN	PRESIDIO	RIO GRANDE	FRESH	9,112	8,982	8,834	8,710	8,640	8,640
WEST TEXAS BOLSONS AQUIFER | UPPER SALT BASIN	HUDSPETH	RIO GRANDE	BRACKISH	250	250	250	250	250	250
WEST TEXAS BOLSONS AQUIFER | UPPER SALT BASIN	CULBERSON	RIO GRANDE	BRACKISH	16,851	16,851	16,851	16,851	16,851	16,851
GROUNDWATER TOTAL SOURCE AVAILABILITY				**901,251**	**901,050**	**900,758**	**900,551**	**900,420**	**900,420**

REGION E

REUSE	COUNTY	BASIN	SALINITY	SOURCE AVAILABILITY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
DIRECT REUSE	EL PASO	RIO GRANDE	FRESH	6,000	6,000	6,000	6,000	6,000	6,000
INDIRECT REUSE	EL PASO	RIO GRANDE	FRESH	31,002	32,939	34,799	36,922	39,105	41,102
INDIRECT REUSE	HUDSPETH	RIO GRANDE	FRESH	334	334	334	334	334	334
REUSE TOTAL SOURCE AVAILABILITY				**37,336**	**39,273**	**41,133**	**43,256**	**45,439**	**47,436**

REGION E

SURFACE WATER	COUNTY	BASIN	SALINITY	SOURCE AVAILABILITY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
RIO GRANDE LIVESTOCK LOCAL SUPPLY | SURFACE WATER	BREWSTER	RIO GRANDE	FRESH	19	19	19	19	19	19
RIO GRANDE LIVESTOCK LOCAL SUPPLY | SURFACE WATER	CULBERSON	RIO GRANDE	FRESH	15	15	15	15	15	15
RIO GRANDE LIVESTOCK LOCAL SUPPLY | SURFACE WATER	EL PASO	RIO GRANDE	FRESH	26	26	26	26	26	26
RIO GRANDE LIVESTOCK LOCAL SUPPLY | SURFACE WATER	HUDSPETH	RIO GRANDE	FRESH	81	81	81	81	81	81
RIO GRANDE LIVESTOCK LOCAL SUPPLY | SURFACE WATER	JEFF DAVIS	RIO GRANDE	FRESH	25	25	25	25	25	25
RIO GRANDE LIVESTOCK LOCAL SUPPLY | SURFACE WATER	PRESIDIO	RIO GRANDE	FRESH	41	41	41	41	41	41
RIO GRANDE LIVESTOCK LOCAL SUPPLY | SURFACE WATER	TERRELL	RIO GRANDE	FRESH	4	4	4	4	4	4
RIO GRANDE OTHER LOCAL SUPPLY | SURFACE WATER	CULBERSON	RIO GRANDE	FRESH	78	78	78	78	78	78

Source Availability

REGION E

SURFACE WATER	COUNTY	BASIN	SALINITY	SOURCE AVAILABILITY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
RIO GRANDE OTHER LOCAL SUPPLY | SURFACE WATER	EL PASO	RIO GRANDE	FRESH	3,026	3,026	3,026	3,026	3,026	3,026
RIO GRANDE OTHER LOCAL SUPPLY | SURFACE WATER	HUDSPETH	RIO GRANDE	FRESH	240	240	240	240	240	240
RIO GRANDE OTHER LOCAL SUPPLY | SURFACE WATER	JEFF DAVIS	RIO GRANDE	FRESH	50	50	50	50	50	50
RIO GRANDE OTHER LOCAL SUPPLY | SURFACE WATER	TERRELL	RIO GRANDE	FRESH	40	40	40	40	40	40
RIO GRANDE RUN-OF-RIVER	BREWSTER	RIO GRANDE	FRESH	8,082	8,082	8,082	8,082	8,082	8,082
RIO GRANDE RUN-OF-RIVER	EL PASO	RIO GRANDE	FRESH	66,631	66,631	66,631	66,631	66,631	66,631
RIO GRANDE RUN-OF-RIVER	HUDSPETH	RIO GRANDE	FRESH	1,150	1,150	1,150	1,150	1,150	1,150
RIO GRANDE RUN-OF-RIVER	PRESIDIO	RIO GRANDE	FRESH	10,853	10,853	10,853	10,853	10,853	10,853
RIO GRANDE RUN-OF-RIVER	TERRELL	RIO GRANDE	FRESH	676	676	676	676	676	676
SURFACE WATER TOTAL SOURCE AVAILABILITY				**91,037**	**91,037**	**91,037**	**91,037**	**91,037**	**91,037**
REGION E TOTAL SOURCE AVAILABILITY				**1,029,624**	**1,031,360**	**1,032,928**	**1,034,844**	**1,036,896**	**1,038,893**

Water User Group (WUG) Population

REGION E	WUG POPULATION					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
BREWSTER COUNTY						
RIO GRANDE BASIN						
ALPINE	6,066	6,185	6,231	6,265	6,283	6,293
COUNTY-OTHER	3,661	3,906	3,999	4,069	4,104	4,124
RIO GRANDE BASIN TOTAL POPULATION	**9,727**	**10,091**	**10,230**	**10,334**	**10,387**	**10,417**
BREWSTER COUNTY TOTAL POPULATION	**9,727**	**10,091**	**10,230**	**10,334**	**10,387**	**10,417**
CULBERSON COUNTY						
RIO GRANDE BASIN						
VAN HORN	2,319	2,542	2,641	2,730	2,782	2,815
COUNTY-OTHER	376	412	428	443	451	457
RIO GRANDE BASIN TOTAL POPULATION	**2,695**	**2,954**	**3,069**	**3,173**	**3,233**	**3,272**
CULBERSON COUNTY TOTAL POPULATION	**2,695**	**2,954**	**3,069**	**3,173**	**3,233**	**3,272**
EL PASO COUNTY						
RIO GRANDE BASIN						
ANTHONY	6,210	7,461	8,623	9,774	10,864	11,889
CLINT	926	926	926	926	926	926
EL PASO	734,031	822,625	904,900	986,455	1,063,672	1,136,275
EL PASO COUNTY TORNILLO WID	2,790	2,802	2,814	2,825	2,836	2,846
EL PASO WCID #4	8,858	9,131	9,385	9,636	9,874	10,098
FORT BLISS	8,929	9,282	9,610	9,935	10,242	10,531
HORIZON CITY	28,607	40,995	52,499	63,902	74,699	84,851
HORIZON REGIONAL MUD	24,522	34,026	42,852	51,600	59,883	67,671
LOWER VALLEY WD	33,186	42,193	50,558	58,849	66,699	74,080
SOCORRO	37,031	42,267	47,129	51,949	56,512	60,803
VINTON	2,053	2,139	2,219	2,298	2,373	2,443
COUNTY-OTHER	38,422	42,056	45,430	48,778	51,947	54,927
RIO GRANDE BASIN TOTAL POPULATION	**925,565**	**1,055,903**	**1,176,945**	**1,296,927**	**1,410,527**	**1,517,340**
EL PASO COUNTY TOTAL POPULATION	**925,565**	**1,055,903**	**1,176,945**	**1,296,927**	**1,410,527**	**1,517,340**
HUDSPETH COUNTY						
RIO GRANDE BASIN						
SIERRA BLANCA	620	680	699	713	720	724
COUNTY-OTHER	3,293	3,624	3,725	3,798	3,833	3,851
RIO GRANDE BASIN TOTAL POPULATION	**3,913**	**4,304**	**4,424**	**4,511**	**4,553**	**4,575**
HUDSPETH COUNTY TOTAL POPULATION	**3,913**	**4,304**	**4,424**	**4,511**	**4,553**	**4,575**
JEFF DAVIS COUNTY						
RIO GRANDE BASIN						
FORT DAVIS	1,264	1,264	1,264	1,264	1,264	1,264
COUNTY-OTHER	1,134	1,134	1,134	1,134	1,134	1,134
RIO GRANDE BASIN TOTAL POPULATION	**2,398**	**2,398**	**2,398**	**2,398**	**2,398**	**2,398**
JEFF DAVIS COUNTY TOTAL POPULATION	**2,398**	**2,398**	**2,398**	**2,398**	**2,398**	**2,398**

Water User Group (WUG) Population

REGION E	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
PRESIDIO COUNTY						
RIO GRANDE BASIN						
MARFA	2,203	2,394	2,578	2,781	2,962	3,134
PRESIDIO	4,867	5,247	5,615	6,018	6,379	6,722
COUNTY-OTHER	1,622	1,804	1,981	2,173	2,347	2,511
RIO GRANDE BASIN TOTAL POPULATION	**8,692**	**9,445**	**10,174**	**10,972**	**11,688**	**12,367**
PRESIDIO COUNTY TOTAL POPULATION	**8,692**	**9,445**	**10,174**	**10,972**	**11,688**	**12,367**
TERRELL COUNTY						
RIO GRANDE BASIN						
SANDERSON	889	910	910	910	910	910
COUNTY-OTHER	156	159	159	159	159	159
RIO GRANDE BASIN TOTAL POPULATION	**1,045**	**1,069**	**1,069**	**1,069**	**1,069**	**1,069**
TERRELL COUNTY TOTAL POPULATION	**1,045**	**1,069**	**1,069**	**1,069**	**1,069**	**1,069**
REGION E TOTAL POPULATION	**954,035**	**1,086,164**	**1,208,309**	**1,329,384**	**1,443,855**	**1,551,438**

Water User Group (WUG) Demand

REGION E	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
BREWSTER COUNTY						
RIO GRANDE BASIN						
ALPINE	1,935	1,944	1,936	1,934	1,937	1,940
COUNTY-OTHER	563	583	584	588	591	594
MANUFACTURING	4	4	4	4	4	4
LIVESTOCK	386	386	386	386	386	386
IRRIGATION	2,304	2,293	2,280	2,269	2,258	2,247
RIO GRANDE BASIN TOTAL DEMAND	**5,192**	**5,210**	**5,190**	**5,181**	**5,176**	**5,171**
BREWSTER COUNTY TOTAL DEMAND	**5,192**	**5,210**	**5,190**	**5,181**	**5,176**	**5,171**
CULBERSON COUNTY						
RIO GRANDE BASIN						
VAN HORN	662	711	737	761	775	784
COUNTY-OTHER	65	70	71	73	74	75
MINING	506	1,240	1,393	1,110	843	640
LIVESTOCK	300	300	300	300	300	300
IRRIGATION	39,928	39,074	38,238	37,420	36,619	35,835
RIO GRANDE BASIN TOTAL DEMAND	**41,461**	**41,395**	**40,739**	**39,664**	**38,611**	**37,634**
CULBERSON COUNTY TOTAL DEMAND	**41,461**	**41,395**	**40,739**	**39,664**	**38,611**	**37,634**
EL PASO COUNTY						
RIO GRANDE BASIN						
ANTHONY	734	852	965	1,083	1,201	1,313
CLINT	92	88	84	83	83	83
EL PASO	110,573	120,315	129,713	139,978	150,602	160,792
EL PASO COUNTY TORNILLO WID	279	272	267	264	264	265
EL PASO WCID #4	811	793	781	783	799	817
FORT BLISS	1,648	1,662	1,696	1,750	1,800	1,850
HORIZON CITY	4,458	6,309	8,047	9,775	11,414	12,959
HORIZON REGIONAL MUD	3,673	5,022	6,291	7,555	8,757	9,891
LOWER VALLEY WD	3,574	4,349	5,086	5,855	6,621	7,348
SOCORRO	3,176	3,447	3,716	4,028	4,365	4,691
VINTON	248	254	260	267	275	283
COUNTY-OTHER	6,646	7,042	7,498	8,032	8,537	9,023
MANUFACTURING	16,138	17,265	18,355	19,282	20,758	22,347
MINING	4,008	4,626	5,262	5,948	6,693	7,539
STEAM ELECTRIC POWER	6,937	8,111	9,541	11,284	13,410	15,937
LIVESTOCK	629	629	629	629	629	629
IRRIGATION	242,798	240,848	232,380	228,579	224,840	221,162
RIO GRANDE BASIN TOTAL DEMAND	**406,422**	**421,884**	**430,571**	**445,175**	**461,048**	**476,929**
EL PASO COUNTY TOTAL DEMAND	**406,422**	**421,884**	**430,571**	**445,175**	**461,048**	**476,929**
HUDSPETH COUNTY						
RIO GRANDE BASIN						
SIERRA BLANCA	151	162	165	167	168	169
COUNTY-OTHER	347	365	363	364	366	368
MANUFACTURING	2	2	2	2	2	2
MINING	479	451	468	483	492	502
LIVESTOCK	541	541	541	541	541	541
IRRIGATION	178,840	175,132	171,501	167,945	164,463	161,053
RIO GRANDE BASIN TOTAL DEMAND	**180,360**	**176,653**	**173,040**	**169,502**	**166,032**	**162,635**
HUDSPETH COUNTY TOTAL DEMAND	**180,360**	**176,653**	**173,040**	**169,502**	**166,032**	**162,635**

Water User Group (WUG) Demand

REGION E	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
JEFF DAVIS COUNTY						
RIO GRANDE BASIN						
FORT DAVIS	297	292	288	286	285	285
COUNTY-OTHER	168	163	158	156	155	155
LIVESTOCK	495	495	495	495	495	495
IRRIGATION	2,560	2,547	2,534	2,521	2,504	2,490
RIO GRANDE BASIN TOTAL DEMAND	**3,520**	**3,497**	**3,475**	**3,458**	**3,439**	**3,425**
JEFF DAVIS COUNTY TOTAL DEMAND	**3,520**	**3,497**	**3,475**	**3,458**	**3,439**	**3,425**
PRESIDIO COUNTY						
RIO GRANDE BASIN						
MARFA	589	627	667	718	764	808
PRESIDIO	659	689	721	764	808	851
COUNTY-OTHER	249	267	287	313	338	361
MINING	403	0	0	0	0	0
LIVESTOCK	408	408	408	408	408	408
IRRIGATION	4,630	4,539	4,450	4,363	4,278	4,197
RIO GRANDE BASIN TOTAL DEMAND	**6,938**	**6,530**	**6,533**	**6,566**	**6,596**	**6,625**
PRESIDIO COUNTY TOTAL DEMAND	**6,938**	**6,530**	**6,533**	**6,566**	**6,596**	**6,625**
TERRELL COUNTY						
RIO GRANDE BASIN						
SANDERSON	202	202	200	199	199	199
COUNTY-OTHER	19	19	19	19	19	19
MINING	673	776	740	606	483	385
LIVESTOCK	238	238	238	238	238	238
IRRIGATION	379	369	359	354	344	337
RIO GRANDE BASIN TOTAL DEMAND	**1,511**	**1,604**	**1,556**	**1,416**	**1,283**	**1,178**
TERRELL COUNTY TOTAL DEMAND	**1,511**	**1,604**	**1,556**	**1,416**	**1,283**	**1,178**
REGION E TOTAL DEMAND	**645,404**	**656,773**	**661,104**	**670,962**	**682,185**	**693,597**

Water User Group (WUG) Existing Water Supply

REGION E	SOURCE REGION | SOURCE NAME	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
BREWSTER COUNTY							
RIO GRANDE BASIN							
ALPINE	E | IGNEOUS AQUIFER | BREWSTER COUNTY	1,428	1,428	1,428	1,428	1,428	1,428
ALPINE	E | IGNEOUS AQUIFER | JEFF DAVIS COUNTY	738	738	738	738	738	738
COUNTY-OTHER	E | EDWARDS-TRINITY-PLATEAU AQUIFER FRESH/BRACKISH | BREWSTER COUNTY	28	28	28	28	28	28
COUNTY-OTHER	E | IGNEOUS AQUIFER | BREWSTER COUNTY	554	554	554	554	554	554
COUNTY-OTHER	E | MARATHON AQUIFER | BREWSTER COUNTY	96	96	96	96	96	96
COUNTY-OTHER	E | OTHER AQUIFER | BREWSTER COUNTY	388	388	388	388	388	388
MANUFACTURING	E | IGNEOUS AQUIFER | BREWSTER COUNTY	4	4	4	4	4	4
LIVESTOCK	E | CAPITAN REEF COMPLEX AQUIFER FRESH/BRACKISH | BREWSTER COUNTY	112	112	112	112	112	112
LIVESTOCK	E | EDWARDS-TRINITY-PLATEAU AQUIFER FRESH/BRACKISH | BREWSTER COUNTY	112	112	112	112	112	112
LIVESTOCK	E | IGNEOUS AQUIFER | BREWSTER COUNTY	112	112	112	112	112	112
LIVESTOCK	E | MARATHON AQUIFER | BREWSTER COUNTY	31	31	31	31	31	31
LIVESTOCK	E | RIO GRANDE LIVESTOCK LOCAL SUPPLY	19	19	19	19	19	19
IRRIGATION	E | IGNEOUS AQUIFER | BREWSTER COUNTY	291	291	291	291	291	291
IRRIGATION	E | OTHER AQUIFER | BREWSTER COUNTY	2,381	2,381	2,381	2,381	2,381	2,381
IRRIGATION	E | RIO GRANDE RUN-OF-RIVER	600	600	600	600	600	600
RIO GRANDE BASIN TOTAL EXISTING SUPPLY		**6,894**	**6,894**	**6,894**	**6,894**	**6,894**	**6,894**
BREWSTER COUNTY TOTAL EXISTING SUPPLY		**6,894**	**6,894**	**6,894**	**6,894**	**6,894**	**6,894**
CULBERSON COUNTY							
RIO GRANDE BASIN							
VAN HORN	E | WEST TEXAS BOLSONS AQUIFER FRESH/BRACKISH | CULBERSON COUNTY	1,351	1,351	1,351	1,351	1,351	1,351
COUNTY-OTHER	E | EDWARDS-TRINITY-PLATEAU AQUIFER | CULBERSON COUNTY	3	3	3	3	3	3
COUNTY-OTHER	E | RUSTLER AQUIFER BRACKISH/SALINE | CULBERSON COUNTY	1	1	1	1	1	1
COUNTY-OTHER	E | WEST TEXAS BOLSONS AQUIFER BRACKISH | CULBERSON COUNTY	10	10	10	10	10	10
COUNTY-OTHER	E | WEST TEXAS BOLSONS AQUIFER FRESH/BRACKISH | CULBERSON COUNTY	126	126	126	126	126	126
MINING	E | RIO GRANDE OTHER LOCAL SUPPLY	78	78	78	78	78	78
MINING	E | RUSTLER AQUIFER BRACKISH/SALINE | CULBERSON COUNTY	47	47	47	47	47	47
MINING	E | WEST TEXAS BOLSONS AQUIFER BRACKISH | CULBERSON COUNTY	45	45	45	45	45	45
MINING	E | WEST TEXAS BOLSONS AQUIFER FRESH/BRACKISH | CULBERSON COUNTY	45	45	45	45	45	45
LIVESTOCK	E | EDWARDS-TRINITY-PLATEAU AQUIFER | CULBERSON COUNTY	29	29	29	29	29	29
LIVESTOCK	E | RIO GRANDE LIVESTOCK LOCAL SUPPLY	15	15	15	15	15	15
LIVESTOCK	E | RUSTLER AQUIFER BRACKISH/SALINE | CULBERSON COUNTY	28	28	28	28	28	28
LIVESTOCK	E | WEST TEXAS BOLSONS AQUIFER BRACKISH | CULBERSON COUNTY	86	86	86	86	86	86
LIVESTOCK	E | WEST TEXAS BOLSONS AQUIFER FRESH/BRACKISH | CULBERSON COUNTY	142	142	142	142	142	142
IRRIGATION	E | CAPITAN REEF COMPLEX AQUIFER FRESH/BRACKISH | CULBERSON COUNTY	7,563	7,563	7,563	7,563	7,563	7,563
IRRIGATION	E | WEST TEXAS BOLSONS AQUIFER FRESH/BRACKISH | CULBERSON COUNTY	32,422	32,422	32,422	32,422	32,422	32,422

Water User Group (WUG) Existing Water Supply

REGION E	SOURCE REGION | SOURCE NAME	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
CULBERSON COUNTY							
RIO GRANDE BASIN TOTAL EXISTING SUPPLY		**41,991**	**41,991**	**41,991**	**41,991**	**41,991**	**41,991**
CULBERSON COUNTY TOTAL EXISTING SUPPLY		**41,991**	**41,991**	**41,991**	**41,991**	**41,991**	**41,991**
EL PASO COUNTY							
RIO GRANDE BASIN							
EL PASO WCID #4	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	1,065	1,065	1,065	1,065	1,065	1,065
EL PASO	E | DIRECT REUSE	6,000	6,000	6,000	6,000	6,000	6,000
EL PASO	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	115,000	115,000	115,000	115,000	115,000	115,000
EL PASO	E | RIO GRANDE RUN-OF-RIVER	10,000	10,000	10,000	10,000	10,000	10,000
HORIZON REGIONAL MUD	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	1,746	1,746	1,746	1,746	1,746	1,746
HORIZON REGIONAL MUD	E | OTHER AQUIFER BRACKISH | EL PASO COUNTY	694	694	694	694	694	694
LOWER VALLEY WD	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	1,121	1,121	1,121	1,121	1,121	1,121
ANTHONY	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	1,202	1,202	1,202	1,202	1,202	1,202
CLINT	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	276	276	276	276	276	276
FORT BLISS	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	1,750	1,750	1,750	1,750	1,750	1,750
SOCORRO	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	2,959	2,959	2,959	2,959	2,959	2,959
VINTON	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	400	400	400	400	400	400
HORIZON CITY	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	2,222	2,222	2,222	2,222	2,222	2,222
HORIZON CITY	E | OTHER AQUIFER BRACKISH | EL PASO COUNTY	884	884	884	884	884	884
EL PASO COUNTY TORNILLO WID	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	484	484	484	484	484	484
COUNTY-OTHER	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	6,278	6,278	6,278	6,278	6,278	6,278
MANUFACTURING	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	7,297	7,297	7,297	7,297	7,297	7,297
MINING	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	680	680	680	680	680	680
MINING	E | OTHER AQUIFER BRACKISH | EL PASO COUNTY	2,000	2,000	2,000	2,000	2,000	2,000
MINING	E | RIO GRANDE OTHER LOCAL SUPPLY	3,026	3,026	3,026	3,026	3,026	3,026
STEAM ELECTRIC POWER	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	3,286	3,286	3,286	3,286	3,286	3,286
LIVESTOCK	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	603	603	603	603	603	603
LIVESTOCK	E | RIO GRANDE LIVESTOCK LOCAL SUPPLY	26	26	26	26	26	26
IRRIGATION	E | OTHER AQUIFER BRACKISH | EL PASO COUNTY	80,000	80,000	80,000	80,000	80,000	80,000
IRRIGATION	E | RIO GRANDE INDIRECT REUSE	31,002	32,939	34,799	36,922	37,697	37,697
IRRIGATION	E | RIO GRANDE RUN-OF-RIVER	56,631	56,631	56,631	56,631	56,631	56,631
RIO GRANDE BASIN TOTAL EXISTING SUPPLY		**336,632**	**338,569**	**340,429**	**342,552**	**343,327**	**343,327**
EL PASO COUNTY TOTAL EXISTING SUPPLY		**336,632**	**338,569**	**340,429**	**342,552**	**343,327**	**343,327**
HUDSPETH COUNTY							
RIO GRANDE BASIN							
SIERRA BLANCA	E | WEST TEXAS BOLSONS AQUIFER FRESH/BRACKISH | CULBERSON COUNTY	842	842	842	842	842	842

Water User Group (WUG) Existing Water Supply

REGION E	SOURCE REGION | SOURCE NAME	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
HUDSPETH COUNTY							
RIO GRANDE BASIN							
COUNTY-OTHER	E | BONE SPRING-VICTORIO PEAK AQUIFER FRESH/BRACKISH | HUDSPETH COUNTY	63	63	63	63	63	63
COUNTY-OTHER	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | HUDSPETH COUNTY	122	122	122	122	122	122
COUNTY-OTHER	E | OTHER AQUIFER BRACKISH | HUDSPETH COUNTY	731	731	731	731	731	731
MANUFACTURING	E | OTHER AQUIFER BRACKISH | HUDSPETH COUNTY	10	10	10	10	10	10
MINING	E | OTHER AQUIFER BRACKISH | HUDSPETH COUNTY	21	21	21	21	21	21
MINING	E | RIO GRANDE OTHER LOCAL SUPPLY	240	240	240	240	240	240
MINING	E | WEST TEXAS BOLSONS AQUIFER BRACKISH | HUDSPETH COUNTY	220	220	220	220	220	220
LIVESTOCK	E | BONE SPRING-VICTORIO PEAK AQUIFER FRESH/BRACKISH | HUDSPETH COUNTY	23	23	23	23	23	23
LIVESTOCK	E | CAPITAN REEF COMPLEX AQUIFER FRESH/BRACKISH | HUDSPETH COUNTY	10	10	10	10	10	10
LIVESTOCK	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | HUDSPETH COUNTY	64	64	64	64	64	64
LIVESTOCK	E | OTHER AQUIFER | HUDSPETH COUNTY	322	322	322	322	322	322
LIVESTOCK	E | RIO GRANDE LIVESTOCK LOCAL SUPPLY	81	81	81	81	81	81
LIVESTOCK	E | WEST TEXAS BOLSONS AQUIFER FRESH/BRACKISH | HUDSPETH COUNTY	41	41	41	41	41	41
IRRIGATION	E | BONE SPRING-VICTORIO PEAK AQUIFER FRESH/BRACKISH | HUDSPETH COUNTY	63,843	63,843	63,843	63,843	63,843	63,843
IRRIGATION	E | CAPITAN REEF COMPLEX AQUIFER FRESH/BRACKISH | HUDSPETH COUNTY	5,000	5,000	5,000	5,000	5,000	5,000
IRRIGATION	E | OTHER AQUIFER BRACKISH | HUDSPETH COUNTY	14,000	14,000	14,000	14,000	14,000	14,000
IRRIGATION	E | RIO GRANDE INDIRECT REUSE	334	334	334	334	334	334
IRRIGATION	E | RIO GRANDE RUN-OF-RIVER	816	816	816	816	816	816
RIO GRANDE BASIN TOTAL EXISTING SUPPLY		**86,783**	**86,783**	**86,783**	**86,783**	**86,783**	**86,783**
HUDSPETH COUNTY TOTAL EXISTING SUPPLY		**86,783**	**86,783**	**86,783**	**86,783**	**86,783**	**86,783**
JEFF DAVIS COUNTY							
RIO GRANDE BASIN							
FORT DAVIS	E | IGNEOUS AQUIFER | JEFF DAVIS COUNTY	343	343	343	343	343	343
COUNTY-OTHER	E | EDWARDS-TRINITY-PLATEAU AQUIFER | JEFF DAVIS COUNTY	10	10	10	10	10	10
COUNTY-OTHER	E | IGNEOUS AQUIFER | JEFF DAVIS COUNTY	428	428	428	428	428	428
COUNTY-OTHER	E | OTHER AQUIFER | JEFF DAVIS COUNTY	196	196	196	196	196	196
COUNTY-OTHER	E | WEST TEXAS BOLSONS AQUIFER FRESH/BRACKISH | JEFF DAVIS COUNTY	38	38	38	38	38	38
LIVESTOCK	E | EDWARDS-TRINITY-PLATEAU AQUIFER | JEFF DAVIS COUNTY	117	117	117	117	117	117
LIVESTOCK	E | IGNEOUS AQUIFER | JEFF DAVIS COUNTY	70	70	70	70	70	70
LIVESTOCK	E | OTHER AQUIFER | JEFF DAVIS COUNTY	212	212	212	212	212	212
LIVESTOCK	E | RIO GRANDE LIVESTOCK LOCAL SUPPLY	25	25	25	25	25	25
LIVESTOCK	E | WEST TEXAS BOLSONS AQUIFER FRESH/BRACKISH | JEFF DAVIS COUNTY	71	71	71	71	71	71
IRRIGATION	E | IGNEOUS AQUIFER | JEFF DAVIS COUNTY	735	735	735	735	735	735
IRRIGATION	E | RIO GRANDE OTHER LOCAL SUPPLY	50	50	50	50	50	50
IRRIGATION	E | WEST TEXAS BOLSONS AQUIFER FRESH/BRACKISH | JEFF DAVIS COUNTY	2,572	2,572	2,572	2,572	2,572	2,572

Water User Group (WUG) Existing Water Supply

REGION E	SOURCE REGION | SOURCE NAME	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
JEFF DAVIS COUNTY							
RIO GRANDE BASIN TOTAL EXISTING SUPPLY		**4,867**	**4,867**	**4,867**	**4,867**	**4,867**	**4,867**
JEFF DAVIS COUNTY TOTAL EXISTING SUPPLY		**4,867**	**4,867**	**4,867**	**4,867**	**4,867**	**4,867**
PRESIDIO COUNTY							
RIO GRANDE BASIN							
MARFA	E | IGNEOUS AQUIFER | PRESIDIO COUNTY	1,774	1,774	1,774	1,774	1,774	1,774
PRESIDIO	E | WEST TEXAS BOLSONS AQUIFER FRESH/BRACKISH | PRESIDIO COUNTY	3,589	3,589	3,589	3,589	3,589	3,589
COUNTY-OTHER	E | IGNEOUS AQUIFER | PRESIDIO COUNTY	353	353	353	353	353	353
COUNTY-OTHER	E | OTHER AQUIFER | PRESIDIO COUNTY	223	223	223	223	223	223
COUNTY-OTHER	E | WEST TEXAS BOLSONS AQUIFER FRESH/BRACKISH | PRESIDIO COUNTY	12	12	12	12	12	12
MINING	E | OTHER AQUIFER | PRESIDIO COUNTY	403	403	403	403	403	403
LIVESTOCK	E | IGNEOUS AQUIFER | PRESIDIO COUNTY	81	81	81	81	81	81
LIVESTOCK	E | OTHER AQUIFER | PRESIDIO COUNTY	143	143	143	143	143	143
LIVESTOCK	E | RIO GRANDE LIVESTOCK LOCAL SUPPLY	41	41	41	41	41	41
LIVESTOCK	E | WEST TEXAS BOLSONS AQUIFER | PRESIDIO COUNTY	81	81	81	81	81	81
LIVESTOCK	E | WEST TEXAS BOLSONS AQUIFER FRESH/BRACKISH | PRESIDIO COUNTY	62	62	62	62	62	62
IRRIGATION	E | IGNEOUS AQUIFER | PRESIDIO COUNTY	400	400	400	400	400	400
IRRIGATION	E | RIO GRANDE RUN-OF-RIVER	6,140	6,140	6,140	6,140	6,140	6,140
IRRIGATION	E | WEST TEXAS BOLSONS AQUIFER | PRESIDIO COUNTY	1,231	1,231	1,231	1,231	1,231	1,231
IRRIGATION	E | WEST TEXAS BOLSONS AQUIFER FRESH/BRACKISH | PRESIDIO COUNTY	1,230	1,230	1,230	1,230	1,230	1,230
RIO GRANDE BASIN TOTAL EXISTING SUPPLY		**15,763**	**15,763**	**15,763**	**15,763**	**15,763**	**15,763**
PRESIDIO COUNTY TOTAL EXISTING SUPPLY		**15,763**	**15,763**	**15,763**	**15,763**	**15,763**	**15,763**
TERRELL COUNTY							
RIO GRANDE BASIN							
SANDERSON	E | EDWARDS-TRINITY-PLATEAU AQUIFER | TERRELL COUNTY	527	527	527	527	527	527
COUNTY-OTHER	E | EDWARDS-TRINITY-PLATEAU AQUIFER | TERRELL COUNTY	61	61	61	61	61	61
MINING	E | EDWARDS-TRINITY-PLATEAU AQUIFER | TERRELL COUNTY	184	184	184	184	184	184
MINING	E | RIO GRANDE OTHER LOCAL SUPPLY	40	40	40	40	40	40
LIVESTOCK	E | EDWARDS-TRINITY-PLATEAU AQUIFER | TERRELL COUNTY	234	234	234	234	234	234
LIVESTOCK	E | RIO GRANDE LIVESTOCK LOCAL SUPPLY	4	4	4	4	4	4
IRRIGATION	E | EDWARDS-TRINITY-PLATEAU AQUIFER | TERRELL COUNTY	415	415	415	415	415	415
IRRIGATION	E | RIO GRANDE RUN-OF-RIVER	676	676	676	676	676	676
RIO GRANDE BASIN TOTAL EXISTING SUPPLY		**2,141**	**2,141**	**2,141**	**2,141**	**2,141**	**2,141**
TERRELL COUNTY TOTAL EXISTING SUPPLY		**2,141**	**2,141**	**2,141**	**2,141**	**2,141**	**2,141**
	REGION E TOTAL EXISTING SUPPLY	**495,071**	**497,008**	**498,868**	**500,991**	**501,766**	**501,766**

Source Water Balance (Availability- WUG Supply)

REGION E									
				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
GROUNDWATER	COUNTY	BASIN	SALINITY	2020	2030	2040	2050	2060	2070
BONE SPRING-VICTORIO PEAK AQUIFER	HUDSPETH	RIO GRANDE	FRESH/BRACKISH	37,500	37,500	37,500	37,500	37,500	37,500
CAPITAN REEF COMPLEX AQUIFER	BREWSTER	RIO GRANDE	FRESH/BRACKISH	1,988	1,988	1,988	1,988	1,988	1,988
CAPITAN REEF COMPLEX AQUIFER	CULBERSON	RIO GRANDE	FRESH/BRACKISH	17	17	17	17	17	17
CAPITAN REEF COMPLEX AQUIFER | NON-RELEVANT	HUDSPETH	RIO GRANDE	FRESH/BRACKISH	90	90	90	90	90	90
EDWARDS-TRINITY-PLATEAU AQUIFER	BREWSTER	RIO GRANDE	FRESH/BRACKISH	1,254	1,254	1,254	1,254	1,254	1,254
EDWARDS-TRINITY-PLATEAU AQUIFER	CULBERSON	RIO GRANDE	FRESH	2,122	2,122	2,122	2,122	2,122	2,122
EDWARDS-TRINITY-PLATEAU AQUIFER	TERRELL	RIO GRANDE	FRESH	0	0	0	0	0	0
EDWARDS-TRINITY-PLATEAU AQUIFER | NON-RELEVANT	JEFF DAVIS	RIO GRANDE	FRESH	8,963	8,963	8,963	8,963	8,963	8,963
HUECO-MESILLA BOLSON AQUIFER	EL PASO	RIO GRANDE	FRESH/BRACKISH	333,631	333,631	333,631	333,631	333,631	333,631
HUECO-MESILLA BOLSON AQUIFER	HUDSPETH	RIO GRANDE	FRESH/BRACKISH	15,814	15,814	15,814	15,814	15,814	15,814
IGNEOUS AQUIFER	BREWSTER	RIO GRANDE	FRESH	197	197	196	194	192	192
IGNEOUS AQUIFER	CULBERSON	RIO GRANDE	FRESH	99	99	99	99	99	99
IGNEOUS AQUIFER	JEFF DAVIS	RIO GRANDE	FRESH	2,270	2,270	2,270	2,270	2,270	2,270
IGNEOUS AQUIFER	PRESIDIO	RIO GRANDE	FRESH	1,456	1,456	1,456	1,455	1,455	1,455
MARATHON AQUIFER	BREWSTER	RIO GRANDE	FRESH	7,200	7,200	7,200	7,200	7,200	7,200
OTHER AQUIFER | BALMORHEA ALLUVIUM	JEFF DAVIS	RIO GRANDE	FRESH	92	92	92	92	92	92
OTHER AQUIFER | BREWSTER CRETACEOUS	BREWSTER	RIO GRANDE	FRESH	31	31	31	31	31	31
OTHER AQUIFER | DIABLO PLATEAU	HUDSPETH	RIO GRANDE	FRESH	26,078	26,078	26,078	26,078	26,078	26,078
OTHER AQUIFER | PRESIDIO CRETACEOUS	PRESIDIO	RIO GRANDE	FRESH	231	231	231	231	231	231
OTHER AQUIFER | RIO GRANDE ALLUVIUM	EL PASO	RIO GRANDE	BRACKISH	46,802	46,802	46,802	46,802	46,802	46,802
OTHER AQUIFER | RIO GRANDE ALLUVIUM	HUDSPETH	RIO GRANDE	BRACKISH	238	238	238	238	238	238
RUSTLER AQUIFER	BREWSTER	RIO GRANDE	BRACKISH/SALINE	0	0	0	0	0	0
RUSTLER AQUIFER	CULBERSON	RIO GRANDE	BRACKISH/SALINE	924	924	924	924	924	924
WEST TEXAS BOLSONS AQUIFER | EAGLE FLAT	HUDSPETH	RIO GRANDE	FRESH/BRACKISH	2,855	2,855	2,855	2,855	2,855	2,855
WEST TEXAS BOLSONS AQUIFER | GREEN RIVER VALLEY	HUDSPETH	RIO GRANDE	FRESH/BRACKISH	69	69	69	69	69	69
WEST TEXAS BOLSONS AQUIFER | GREEN RIVER VALLEY	JEFF DAVIS	RIO GRANDE	FRESH/BRACKISH	82	82	82	82	82	82
WEST TEXAS BOLSONS AQUIFER | GREEN RIVER VALLEY	PRESIDIO	RIO GRANDE	FRESH/BRACKISH	82	82	82	82	82	82

Source Water Balance (Availability- WUG Supply)

REGION E

GROUNDWATER	COUNTY	BASIN	SALINITY	SOURCE WATER BALANCE (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
WEST TEXAS BOLSONS AQUIFER | PRESIDIO-REDFORD	PRESIDIO	RIO GRANDE	FRESH/BRACKISH	1,389	1,389	1,389	1,389	1,389	1,389
WEST TEXAS BOLSONS AQUIFER | RED LIGHT DRAW	HUDSPETH	RIO GRANDE	FRESH/BRACKISH	1,617	1,617	1,617	1,617	1,617	1,617
WEST TEXAS BOLSONS AQUIFER | SALT BASIN	CULBERSON	RIO GRANDE	FRESH/BRACKISH	821	750	673	622	581	581
WEST TEXAS BOLSONS AQUIFER | SALT BASIN	JEFF DAVIS	RIO GRANDE	FRESH/BRACKISH	3,374	3,374	3,308	3,279	3,261	3,261
WEST TEXAS BOLSONS AQUIFER | SALT BASIN	PRESIDIO	RIO GRANDE	FRESH	7,800	7,670	7,522	7,398	7,328	7,328
WEST TEXAS BOLSONS AQUIFER | UPPER SALT BASIN	HUDSPETH	RIO GRANDE	BRACKISH	30	30	30	30	30	30
WEST TEXAS BOLSONS AQUIFER | UPPER SALT BASIN	CULBERSON	RIO GRANDE	BRACKISH	16,710	16,710	16,710	16,710	16,710	16,710
GROUNDWATER TOTAL SOURCE WATER BALANCE				**521,826**	**521,625**	**521,333**	**521,126**	**520,995**	**520,995**

REGION E

REUSE	COUNTY	BASIN	SALINITY	SOURCE WATER BALANCE (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
DIRECT REUSE	EL PASO	RIO GRANDE	FRESH	0	0	0	0	0	0
INDIRECT REUSE	EL PASO	RIO GRANDE	FRESH	0	0	0	0	1,408	3,405
INDIRECT REUSE	HUDSPETH	RIO GRANDE	FRESH	0	0	0	0	0	0
REUSE TOTAL SOURCE WATER BALANCE				**0**	**0**	**0**	**0**	**1,408**	**3,405**

REGION E

SURFACE WATER	COUNTY	BASIN	SALINITY	SOURCE WATER BALANCE (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
RIO GRANDE LIVESTOCK LOCAL SUPPLY | SURFACE WATER	BREWSTER	RIO GRANDE	FRESH	0	0	0	0	0	0
RIO GRANDE LIVESTOCK LOCAL SUPPLY | SURFACE WATER	CULBERSON	RIO GRANDE	FRESH	0	0	0	0	0	0
RIO GRANDE LIVESTOCK LOCAL SUPPLY | SURFACE WATER	EL PASO	RIO GRANDE	FRESH	0	0	0	0	0	0
RIO GRANDE LIVESTOCK LOCAL SUPPLY | SURFACE WATER	HUDSPETH	RIO GRANDE	FRESH	0	0	0	0	0	0
RIO GRANDE LIVESTOCK LOCAL SUPPLY | SURFACE WATER	JEFF DAVIS	RIO GRANDE	FRESH	0	0	0	0	0	0
RIO GRANDE LIVESTOCK LOCAL SUPPLY | SURFACE WATER	PRESIDIO	RIO GRANDE	FRESH	0	0	0	0	0	0
RIO GRANDE LIVESTOCK LOCAL SUPPLY | SURFACE WATER	TERRELL	RIO GRANDE	FRESH	0	0	0	0	0	0
RIO GRANDE OTHER LOCAL SUPPLY | SURFACE WATER	CULBERSON	RIO GRANDE	FRESH	0	0	0	0	0	0

Source Water Balance (Availability- WUG Supply)

REGION E

SURFACE WATER	COUNTY	BASIN	SALINITY	SOURCE WATER BALANCE (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
RIO GRANDE OTHER LOCAL SUPPLY | SURFACE WATER	EL PASO	RIO GRANDE	FRESH	0	0	0	0	0	0
RIO GRANDE OTHER LOCAL SUPPLY | SURFACE WATER	HUDSPETH	RIO GRANDE	FRESH	0	0	0	0	0	0
RIO GRANDE OTHER LOCAL SUPPLY | SURFACE WATER	JEFF DAVIS	RIO GRANDE	FRESH	0	0	0	0	0	0
RIO GRANDE OTHER LOCAL SUPPLY | SURFACE WATER	TERRELL	RIO GRANDE	FRESH	0	0	0	0	0	0
RIO GRANDE RUN-OF-RIVER	BREWSTER	RIO GRANDE	FRESH	7,482	7,482	7,482	7,482	7,482	7,482
RIO GRANDE RUN-OF-RIVER	EL PASO	RIO GRANDE	FRESH	0	0	0	0	0	0
RIO GRANDE RUN-OF-RIVER	HUDSPETH	RIO GRANDE	FRESH	334	334	334	334	334	334
RIO GRANDE RUN-OF-RIVER	PRESIDIO	RIO GRANDE	FRESH	4,713	4,713	4,713	4,713	4,713	4,713
RIO GRANDE RUN-OF-RIVER	TERRELL	RIO GRANDE	FRESH	0	0	0	0	0	0
SURFACE WATER TOTAL SOURCE WATER BALANCE				**12,529**	**12,529**	**12,529**	**12,529**	**12,529**	**12,529**
REGION E TOTAL SOURCE WATER BALANCE				**534,355**	**534,154**	**533,862**	**533,655**	**534,932**	**536,929**

Water User Group (WUG) Needs/Surplus

REGION E	WUG (NEEDS)/SURPLUS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
BREWSTER COUNTY						
RIO GRANDE BASIN						
ALPINE	231	222	230	232	229	226
COUNTY-OTHER	503	483	482	478	475	472
MANUFACTURING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	968	979	992	1,003	1,014	1,025
CULBERSON COUNTY						
RIO GRANDE BASIN						
VAN HORN	689	640	614	590	576	567
COUNTY-OTHER	75	70	69	67	66	65
MINING	(291)	(1,025)	(1,178)	(895)	(628)	(425)
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	57	911	1,747	2,565	3,366	4,150
EL PASO COUNTY						
RIO GRANDE BASIN						
ANTHONY	468	350	237	119	1	(111)
CLINT	184	188	192	193	193	193
EL PASO	20,427	10,685	1,287	(8,978)	(19,602)	(29,792)
EL PASO COUNTY TORNILLO WID	205	212	217	220	220	219
EL PASO WCID #4	254	272	284	282	266	248
FORT BLISS	102	88	54	0	(50)	(100)
HORIZON CITY	(1,352)	(3,203)	(4,941)	(6,669)	(8,308)	(9,853)
HORIZON REGIONAL MUD	(1,233)	(2,582)	(3,851)	(5,115)	(6,317)	(7,451)
LOWER VALLEY WD	(2,453)	(3,228)	(3,965)	(4,734)	(5,500)	(6,227)
SOCORRO	(217)	(488)	(757)	(1,069)	(1,406)	(1,732)
VINTON	152	146	140	133	125	117
COUNTY-OTHER	(368)	(764)	(1,220)	(1,754)	(2,259)	(2,745)
MANUFACTURING	(8,841)	(9,968)	(11,058)	(11,985)	(13,461)	(15,050)
MINING	1,698	1,080	444	(242)	(987)	(1,833)
STEAM ELECTRIC POWER	(3,651)	(4,825)	(6,255)	(7,998)	(10,124)	(12,651)
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	(75,165)	(71,278)	(60,950)	(55,026)	(50,512)	(46,834)
HUDSPETH COUNTY						
RIO GRANDE BASIN						
SIERRA BLANCA	691	680	677	675	674	673
COUNTY-OTHER	569	551	553	552	550	548
MANUFACTURING	8	8	8	8	8	8
MINING	2	30	13	(2)	(11)	(21)
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	(94,847)	(91,139)	(87,508)	(83,952)	(80,470)	(77,060)
JEFF DAVIS COUNTY						
RIO GRANDE BASIN						
FORT DAVIS	46	51	55	57	58	58
COUNTY-OTHER	504	509	514	516	517	517
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	797	810	823	836	853	867

Water User Group (WUG) Needs/Surplus

REGION E	WUG (NEEDS)/SURPLUS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
PRESIDIO COUNTY						
RIO GRANDE BASIN						
MARFA	1,185	1,147	1,107	1,056	1,010	966
PRESIDIO	2,930	2,900	2,868	2,825	2,781	2,738
COUNTY-OTHER	339	321	301	275	250	227
MINING	0	403	403	403	403	403
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	4,371	4,462	4,551	4,638	4,723	4,804
TERRELL COUNTY						
RIO GRANDE BASIN						
SANDERSON	325	325	327	328	328	328
COUNTY-OTHER	42	42	42	42	42	42
MINING	(449)	(552)	(516)	(382)	(259)	(161)
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	712	722	732	737	747	754

Water User Group (WUG) Category Summary

REGION E	2020	2030	2040	2050	2060	2070
MUNICIPAL						
POPULATION	905,371	1,033,069	1,151,453	1,268,830	1,379,880	1,484,275
DEMANDS (acre-feet per year)	133,761	147,990	161,620	176,250	191,117	205,328
EXISTING SUPPLIES (acre-feet per year)	156,395	156,395	156,395	156,395	156,395	156,395
NEEDS (acre-feet per year)*	(5,255)	(9,501)	(13,514)	(26,565)	(41,183)	(55,266)
COUNTY-OTHER						
POPULATION	48,664	53,095	56,856	60,554	63,975	67,163
DEMANDS (acre-feet per year)	8,057	8,509	8,980	9,545	10,080	10,595
EXISTING SUPPLIES (acre-feet per year)	9,721	9,721	9,721	9,721	9,721	9,721
NEEDS (acre-feet per year)*	(368)	(764)	(1,220)	(1,754)	(2,259)	(2,745)
MANUFACTURING						
DEMANDS (acre-feet per year)	16,144	17,271	18,361	19,288	20,764	22,353
EXISTING SUPPLIES (acre-feet per year)	7,311	7,311	7,311	7,311	7,311	7,311
NEEDS (acre-feet per year)*	(8,841)	(9,968)	(11,058)	(11,985)	(13,461)	(15,050)
MINING						
DEMANDS (acre-feet per year)	6,069	7,093	7,863	8,147	8,511	9,066
EXISTING SUPPLIES (acre-feet per year)	7,029	7,029	7,029	7,029	7,029	7,029
NEEDS (acre-feet per year)*	(740)	(1,577)	(1,694)	(1,521)	(1,885)	(2,440)
STEAM ELECTRIC POWER						
DEMANDS (acre-feet per year)	6,937	8,111	9,541	11,284	13,410	15,937
EXISTING SUPPLIES (acre-feet per year)	3,286	3,286	3,286	3,286	3,286	3,286
NEEDS (acre-feet per year)*	(3,651)	(4,825)	(6,255)	(7,998)	(10,124)	(12,651)
LIVESTOCK						
DEMANDS (acre-feet per year)	2,997	2,997	2,997	2,997	2,997	2,997
EXISTING SUPPLIES (acre-feet per year)	2,997	2,997	2,997	2,997	2,997	2,997
NEEDS (acre-feet per year)*	0	0	0	0	0	0
IRRIGATION						
DEMANDS (acre-feet per year)	471,439	464,802	451,742	443,451	435,306	427,321
EXISTING SUPPLIES (acre-feet per year)	308,332	310,269	312,129	314,252	315,027	315,027
NEEDS (acre-feet per year)*	(170,012)	(162,417)	(148,458)	(138,978)	(130,982)	(123,894)
REGION TOTALS						
POPULATION	954,035	1,086,164	1,208,309	1,329,384	1,443,855	1,551,438
DEMANDS (acre-feet per year)	645,404	656,773	661,104	670,962	682,185	693,597
EXISTING SUPPLIES (acre-feet per year)	495,071	497,008	498,868	500,991	501,766	501,766
NEEDS (acre-feet per year)*	(188,867)	(189,052)	(182,199)	(188,801)	(199,894)	(212,046)

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Category Summary report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the Needs totals.

Water User Group (WUG) Second-Tier Identified Water Need

REGION E	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
BREWSTER COUNTY						
RIO GRANDE BASIN						
ALPINE	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
CULBERSON COUNTY						
RIO GRANDE BASIN						
VAN HORN	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MINING	291	1,025	1,178	895	628	425
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
EL PASO COUNTY						
RIO GRANDE BASIN						
ANTHONY	0	0	0	0	0	104
CLINT	0	0	0	0	0	0
EL PASO	0	0	0	0	0	0
EL PASO COUNTY TORNILLO WID	0	0	0	0	0	0
EL PASO WCID #4	0	0	0	0	0	0
FORT BLISS	0	0	0	0	32	81
HORIZON CITY	1,307	3,140	4,861	6,571	8,194	9,723
HORIZON REGIONAL MUD	1,196	2,532	3,788	5,039	6,229	7,352
LOWER VALLEY WD	2,417	3,185	3,914	4,675	5,434	6,154
SOCORRO	185	454	720	1,029	1,362	1,685
VINTON	0	0	0	0	0	0
COUNTY-OTHER	368	755	1,212	1,746	2,251	2,738
MANUFACTURING	8,841	9,968	11,058	11,985	13,461	15,050
MINING	0	0	0	242	987	1,833
STEAM ELECTRIC POWER	3,651	4,825	6,255	7,998	10,124	12,651
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	46,702	42,815	32,487	26,563	22,049	18,371
HUDSPETH COUNTY						
RIO GRANDE BASIN						
SIERRA BLANCA	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	2	11	21
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	90,723	87,015	83,384	79,828	76,346	72,936
JEFF DAVIS COUNTY						
RIO GRANDE BASIN						
FORT DAVIS	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0

Water User Group (WUG) Second-Tier Identified Water Need

REGION E	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
PRESIDIO COUNTY						
RIO GRANDE BASIN						
MARFA	0	0	0	0	0	0
PRESIDIO	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	0	0	0	0	0	0
TERRELL COUNTY						
RIO GRANDE BASIN						
SANDERSON	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MINING	449	552	516	382	259	161
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0

***Second-tier needs are WUG split needs adjusted to include the implementation of recommended demand reduction and direct reuse water management strategies.**

Water User Group (WUG) Second-Tier Identified Water Need Summary

REGION E

	2020	2030	2040	2050	2060	2070
MUNICIPAL	5,105	9,311	13,283	17,314	21,251	25,099
COUNTY-OTHER	368	755	1,212	1,746	2,251	2,738
MANUFACTURING	8,841	9,968	11,058	11,985	13,461	15,050
MINING	740	1,577	1,694	1,521	1,885	2,440
STEAM ELECTRIC POWER	3,651	4,825	6,255	7,998	10,124	12,651
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	137,425	129,830	115,871	106,391	98,395	91,307

*Second-tier needs are WUG split needs adjusted to include the implementation of recommended demand reduction and direct reuse water management strategies.

Water User Group (WUG) Unmet Needs

REGION E	WUG UNMET NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
CULBERSON COUNTY						
RIO GRANDE BASIN						
IRRIGATION	0	0	0	3,435	2,634	1,850
EL PASO COUNTY						
RIO GRANDE BASIN						
IRRIGATION	53,202	49,315	38,987	33,063	28,549	24,871
HUDSPETH COUNTY						
RIO GRANDE BASIN						
IRRIGATION	90,493	86,785	83,154	83,598	80,116	76,706
TERRELL COUNTY						
RIO GRANDE BASIN						
MINING	449	552	516	382	259	161

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The unmet needs shown in the WUG Unmet Needs report are calculated by first deducting the WUG split's projected demand from the sum of its total existing water supply volume and all associated recommended water management strategy water volumes. If the WUG split has a greater future supply volume than projected demand in any given decade, this amount is considered a surplus volume. In order to display only unmet needs associated with the WUG split, these surplus volumes are updated to a zero and the unmet needs water volumes are shown as absolute values.

Water User Group (WUG) Unmet Needs Summary

REGION E

	2020	2030	2040	2050	2060	2070
MUNICIPAL	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	449	552	516	382	259	161
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	143,695	136,100	122,141	120,096	111,299	103,427

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The unmet needs shown in the WUG Unmet Needs Summary report are calculated by first deducting the WUG split's projected demand from the sum of its total existing water supply volume and all associated recommended water management strategy water volumes. If the WUG split has a greater future supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG category level, calculated surpluses are updated to zero so that only the WUGs with unmet needs in the decade are included with the Needs totals. Unmet needs water volumes are shown as absolute values.

Recommended Water User Group (WUG) Water Management Strategies (WMS)

WUG Entity Primary Region: E

WUG Entity Name	WMS Sponsor Region	WMS Name	Source Name	Water Management Strategy Supplies 2020	2030	2040	2050	2060	2070	Unit Cost 2020	Unit Cost 2070
ANTHONY	E	TOWN OF ANTHONY - ADDITIONAL GROUNDWATER WELL	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	960	960	960	960	960	960	$110	$20
ANTHONY	E	TOWN OF ANTHONY - ARSENIC TREATMENT FACILITY	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	2,800	2,800	2,800	2,800	2,800	2,800	$899	$601
ANTHONY	E	TOWN OF ANTHONY - WATER LOSS AUDIT AND MAIN-LINE REPAIR	DEMAND REDUCTION	7	7	7	7	7	7	$9857	$714
COUNTY-OTHER, BREWSTER	E	MARATHON WSSSERVICE - WATER LOSS AUDIT AND MAIN-LINE REPAIR	DEMAND REDUCTION	65	65	65	65	65	65	$600	$46
COUNTY-OTHER, BREWSTER	E	PANTHER JUNCTION BBNP PLT - WATER LOSS AUDIT AND MAIN-LINE REPAIR	DEMAND REDUCTION	2	2	2	2	2	2	$34500	$2500
COUNTY-OTHER, BREWSTER	E	RIO GRANDE VILLAGE BBNP - WATER LOSS AUDIT AND MAIN-LINE REPAIR	DEMAND REDUCTION	6	6	6	6	6	6	$9167	$500
COUNTY-OTHER, EL PASO	E	EL PASO COUNTY OTHER - PURCHASE WATER FROM EPWU	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	368	764	1,220	1,754	2,259	2,745	$679	$679
COUNTY-OTHER, EL PASO	E	EL PASO COUNTY-OTHER - PUBLIC CONSERVATION EDUCATION	DEMAND REDUCTION	0	9	8	8	8	7	N/A	$203
COUNTY-OTHER, HUDSPETH	E	CITY OF SIERRA BLANCA - HUDSPETH CO. WCID #1 - ADDITIONAL TRANSMISSION LINE	E | WEST TEXAS BOLSONS AQUIFER FRESH/BRACKISH | CULBERSON COUNTY	351	351	351	351	351	351	$436	$94
COUNTY-OTHER, HUDSPETH	E	DELL CITY - BRACKISH GROUNDWATER DESALINATION FACILITY	E | BONE SPRING-VICTORIO PEAK AQUIFER FRESH/BRACKISH | HUDSPETH COUNTY	111	111	111	111	111	111	$2541	$1559
COUNTY-OTHER, HUDSPETH	E	DELL CITY - WATER LOSS AUDIT AND MAIN-LINE REPAIR	DEMAND REDUCTION	1	1	1	1	1	1	$145000	$10000
COUNTY-OTHER, HUDSPETH	E	FORT HANCOCK WCID - ADDITIONAL WELL AND RO TREATMENT FACILITY	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | HUDSPETH COUNTY	565	565	565	565	565	565	$1938	$1034
COUNTY-OTHER, HUDSPETH	E	FORT HANCOCK WCID - WATER LOSS AUDIT AND MAIN-LINE REPAIR	DEMAND REDUCTION	3	3	3	3	3	3	$8667	$667
COUNTY-OTHER, JEFF DAVIS	E	TOWN OF VALENTINE - ADDITIONAL GROUNDWATER WELL	E | WEST TEXAS BOLSONS AQUIFER FRESH/BRACKISH | JEFF DAVIS COUNTY	65	65	65	65	65	65	$800	$277
EL PASO	E	EPWU - ADVANCED PURIFIED WATER AT THE BUSTAMANTE WWTP	E | DIRECT REUSE	8,000	9,000	10,000	10,000	10,000	10,000	$1672	$665
EL PASO	E	EPWU - ADVANCED PURIFIED WATER AT THE HASKELL AND NW WWTPS	E | DIRECT REUSE	0	0	3,000	7,500	12,000	16,500	N/A	$1545
EL PASO	E	EPWU - BRACKISH GROUNDWATER AT THE JONATHAN ROGERS WWTP	E | OTHER AQUIFER BRACKISH | EL PASO COUNTY	0	0	11,000	11,000	11,000	11,000	N/A	$427
EL PASO	E	EPWU - EXPANSION OF LOCAL WELL FIELDS	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	3,880	7,760	11,640	15,520	19,400	23,280	$159	$81
EL PASO	E	EPWU - EXPANSION OF THE JONATHAN ROGERS WWTP	E | RIO GRANDE RUN-OF-RIVER	6,500	6,500	6,500	6,500	6,500	6,500	$1697	$472
EL PASO	E	EPWU - EXPANSION OF THE KAY BAILEY HUTCHISON DESAL PLANT	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	1,260	2,520	2,520	2,520	2,520	2,520	$1260	$433

Recommended Water User Group (WUG) Water Management Strategies (WMS)

WUG Entity Name	WMS Sponsor Region	WMS Name	Source Name	Water Management Strategy Supplies 2020	2030	2040	2050	2060	2070	Unit Cost 2020	Unit Cost 2070
EL PASO	E	EPWU - GROUNDWATER FROM DELL CITY AREA	E | BONE SPRING-VICTORIO PEAK AQUIFER FRESH/BRACKISH | HUDSPETH COUNTY	0	0	0	0	10,000	20,000	N/A	$1995
EL PASO	E	EPWU - GROUNDWATER FROM DIABLO FARMS	E | CAPITAN REEF COMPLEX AQUIFER FRESH/BRACKISH | CULBERSON COUNTY	0	0	0	6,000	6,000	6,000	N/A	$488
EL PASO	E	EPWU - GROUNDWATER FROM DIABLO FARMS	E | CAPITAN REEF COMPLEX AQUIFER FRESH/BRACKISH | HUDSPETH COUNTY	0	0	0	4,000	4,000	4,000	N/A	$488
EL PASO	E	EPWU - GROUNDWATER FROM HUECO RANCH	E | OTHER AQUIFER | HUDSPETH COUNTY	0	0	5,000	5,000	5,000	5,000	N/A	$704
EL PASO	E	EPWU - GROUNDWATER FROM SOUTHERN HUDSPETH COUNTY	E | OTHER AQUIFER | HUDSPETH COUNTY	10,000	10,000	10,000	10,000	10,000	10,000	$1466	$637
EL PASO	E	EPWU - MUNICIPAL CONSERVATION PROGRAMS	DEMAND REDUCTION	1,870	2,110	1,160	2,550	5,530	5,910	$642	$203
EL PASO	E	EPWU - RECHARGE OF HUECO AQUIFER WITH TREATED SURFACE WATER FROM JONATHAN ROGERS WWTP	E | RIO GRANDE RUN-OF-RIVER	5,000	5,000	5,000	5,000	5,000	5,000	$403	$361
EL PASO	E	EPWU - RIVERSIDE REGULATING RESERVOIR	E | REGULATING LAKE/RESERVOIR	6,500	6,500	6,500	6,500	6,500	6,500	$341	$267
EL PASO	E	EPWU - TREATMENT AND REUSE OF AGRICULTURAL DRAIN WATER	E | RIO GRANDE INDIRECT REUSE	0	2,700	2,700	2,700	2,700	2,700	N/A	$563
EL PASO COUNTY TORNILLO WID	E	EL PASO CO. TORNILLO WID - ADDITIONAL GROUNDWATER WELL AND TRANSMISSION LINE	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	333	333	333	333	333	333	$598	$165
EL PASO COUNTY TORNILLO WID	E	EL PASO CO. TORNILLO WID - ARSENIC TREATMENT FACILITY	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	276	276	276	276	276	276	$2254	$1308
FORT BLISS	E	FORT BLISS - PUBLIC CONSERVATION EDUCATION	DEMAND REDUCTION	16	17	17	18	18	19	$1169	$1012
FORT BLISS	E	FORT BLISS - PURCHASE WATER FROM EPWU	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	26	40	74	128	178	228	$346	$342
FORT DAVIS	E	FORT DAVIS WSC - ADDITIONAL GROUNDWATER WELL	E | IGNEOUS AQUIFER | JEFF DAVIS COUNTY	274	274	274	274	274	274	$252	$99
FORT DAVIS	E	FORT DAVIS WSC - ADDITIONAL TRANSMISSION LINE	E | IGNEOUS AQUIFER | JEFF DAVIS COUNTY	114	114	114	114	114	114	$956	$175
HORIZON CITY	E	HORIZON CITY - PUBLIC CONSERVATION EDUCATION	DEMAND REDUCTION	45	63	80	98	114	130	$509	$522
HORIZON CITY	E	HORIZON CITY - PURCHASE WATER FROM HORIZON REGIONAL MUD	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	1,746	1,746	1,746	1,746	1,746	1,746	$436	$436
HORIZON CITY	E	HORIZON REGIONAL MUD - ADDITIONAL WELLS AND EXPANSION OF DESAL PLANT	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	0	1,457	3,195	4,923	6,562	8,107	N/A	$6597000
HORIZON REGIONAL MUD	E	HORIZON REGIONAL MUD - ADDITIONAL WELLS AND EXPANSION OF DESAL PLANT	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	8,652	8,652	8,652	8,652	8,652	8,652	$4379	$381
HORIZON REGIONAL MUD	E	HORIZON REGIONAL MUD - ADDITIONAL WELLS AND EXPANSION OF DESAL PLANT	E | OTHER AQUIFER BRACKISH | EL PASO COUNTY	8,652	8,652	8,652	8,652	8,652	8,652	$4379	$381
HORIZON REGIONAL MUD	E	HORIZON REGIONAL MUD - PUBLIC CONSERVATION EDUCATION	DEMAND REDUCTION	37	50	63	76	88	99	$496	$348
IRRIGATION, EL PASO	E	EPCWID #1 - IMPROVEMENTS TO WATER DISTRICT DELIVERY SYSTEM	DEMAND REDUCTION	25,000	25,000	25,000	25,000	25,000	25,000	$9	$9

Recommended Water User Group (WUG) Water Management Strategies (WMS)

WUG Entity Name	WMS Sponsor Region	WMS Name	Source Name	Water Management Strategy Supplies 2020	2030	2040	2050	2060	2070	Unit Cost 2020	Unit Cost 2070
IRRIGATION, EL PASO	E	EPCWID #1 - IRRIGATION SCHEDULING	DEMAND REDUCTION	1,740	1,740	1,740	1,740	1,740	1,740	$59	$59
IRRIGATION, EL PASO	E	EPCWID #1 - TAILWATER REUSE	DEMAND REDUCTION	1,723	1,723	1,723	1,723	1,723	1,723	$565	$565
IRRIGATION, HUDSPETH	E	HCCRD #1 - ADDITIONAL GROUNDWATER WELLS	E | OTHER AQUIFER BRACKISH | HUDSPETH COUNTY	230	230	230	230	230	230	$78	$17
IRRIGATION, HUDSPETH	E	HUDSPETH IRRIGATION - HCUWCD #1 - IRRIGATION SCHEDULING	DEMAND REDUCTION	3,535	3,535	3,535	3,535	3,535	3,535	$29	$29
IRRIGATION, HUDSPETH	E	HUDSPETH IRRIGATION - HCUWCD #1 - TAILWATER REUSE	DEMAND REDUCTION	589	589	589	589	589	589	$1653	$1653
LOWER VALLEY WD	E	LVWD - GROUNDWATER FROM PROPOSED WELL FIELD - HUECO BOLSON AQUIFER	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	6,800	6,800	6,800	6,800	6,800	6,800	$1171	$684
LOWER VALLEY WD	E	LVWD - GROUNDWATER FROM PROPOSED WELL FIELD - RIO GRANDE ALLUVIUM AQUIFER	E | OTHER AQUIFER BRACKISH | EL PASO COUNTY	6,800	6,800	6,800	6,800	6,800	6,800	$1022	$578
LOWER VALLEY WD	E	LVWD - PUBLIC CONSERVATION EDUCATION	DEMAND REDUCTION	36	43	51	59	66	73	$846	$463
LOWER VALLEY WD	E	LVWD - PURCHASE WATER FROM EPWU	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	2,453	3,228	3,965	4,734	5,500	6,227	$436	$436
LOWER VALLEY WD	E	LVWD - SURFACE WATER TREATMENT PLANT AND TRANSMISSION LINE	E | RIO GRANDE RUN-OF-RIVER	6,700	6,700	6,700	6,700	6,700	6,700	$655	$245
LOWER VALLEY WD	E	LVWD - WASTEWATER TREATMENT FACILITY AND ASR	E | HUECO-MESILLA BOLSON AQUIFER ASR FRESH/BRACKISH | EL PASO COUNTY	3,808	3,808	3,808	3,808	3,808	3,808	$694	$296
MANUFACTURING, EL PASO	E	EL PASO COUNTY MANUFACTURING - PURCHASE WATER FROM EPWU	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	8,841	9,968	11,058	11,985	13,461	15,050	$1168	$1168
MARFA	E	CITY OF MARFA - ADDITIONAL GROUNDWATER WELL	E | IGNEOUS AQUIFER | PRESIDIO COUNTY	785	785	785	785	785	785	$233	$102
MINING, CULBERSON	E	CULBERSON COUNTY - ADDITIONAL GROUNDWATER WELLS - RUSTLER AQUIFER	E | RUSTLER AQUIFER BRACKISH/SALINE | CULBERSON COUNTY	590	590	590	590	590	590	$149	$63
MINING, CULBERSON	E	CULBERSON COUNTY MINING - ADDITIONAL GROUNDWATER WELL - WEST TEXAS BOLSONS AQUIFER	E | WEST TEXAS BOLSONS AQUIFER BRACKISH | CULBERSON COUNTY	590	590	590	590	590	590	$154	$59
MINING, EL PASO	E	EL PASO CO. MINING - ADDITIONAL GROUNDWATER WELLS	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	0	0	0	242	987	1,833	N/A	$73
MINING, HUDSPETH	E	HUDSPETH COUNTY MINING - ADDITIONAL GROUNDWATER WELL	E | WEST TEXAS BOLSONS AQUIFER BRACKISH | HUDSPETH COUNTY	30	30	30	30	30	30	$1433	$167
PRESIDIO	E	CITY OF PRESIDIO - ADDITIONAL GROUNDWATER WELL IN THE WEST TEXAS BOLSONS AQUIFER	E | WEST TEXAS BOLSONS AQUIFER FRESH/BRACKISH | PRESIDIO COUNTY	120	120	120	120	120	120	$1558	$258
PRESIDIO	E	CITY OF PRESIDIO - WATER LOSS AUDIT AND MAIN-LINE REPAIR	DEMAND REDUCTION	9	9	9	9	9	9	$21667	$1444
SOCORRO	E	CITY OF SOCORRO - PUBLIC CONSERVATION EDUCATION	DEMAND REDUCTION	32	34	37	40	44	47	$926	$1035
SOCORRO	E	CITY OF SOCORRO - PURCHASE WATER FROM LVWD	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	217	488	757	1,069	1,406	1,732	$438	$436
STEAM ELECTRIC POWER, EL PASO	E	EL PASO SEP - PURCHASE WATER FROM EPWU	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	3,651	4,825	6,255	7,998	10,124	12,651	$475	$475

Recommended Water User Group (WUG) Water Management Strategies (WMS)

WUG Entity Name	WMS Sponsor Region	WMS Name	Source Name	Water Management Strategy Supplies 2020	2030	2040	2050	2060	2070	Unit Cost 2020	Unit Cost 2070
VAN HORN	E	CITY OF VAN HORN - WATER LOSS AUDIT AND MAIN-LINE REPAIR	DEMAND REDUCTION	30	30	30	30	30	30	$3567	$233
VINTON	E	CITY OF VINTON - HIGH CAPACITY WATER LINES FOR IMPROVED DISTRIBUTION OF WATER FROM EPWU	E | HUECO-MESILLA BOLSON AQUIFER FRESH/BRACKISH | EL PASO COUNTY	400	400	400	400	400	400	$878	$0
Region E Total RecommendedWMS Supplies				143,194	157,538	186,262	212,384	241,427	268,320		

Alternative Water User Group (WUG) Water Management Strategies (WMS)

WUG Entity Primary Region: E

WUG Entity Name	WMS Sponsor Region	WMS Name	Source Name	Water Management Strategy Supplies 2020	2030	2040	2050	2060	2070	Unit Cost 2020	Unit Cost 2070
MINING, TERRELL	E	TERRELL COUNTY MINING - ADDITIONAL GROUNDWATER WELLS	E | EDWARDS-TRINITY-PLATEAU AQUIFER | TERRELL COUNTY	560	560	560	560	560	560	$123000	$61000
Region E Total Alternative WMS Supplies				560	560	560	560	560	560		

Recommended Projects Associated with Water Management Strategies

Project Sponosr Region: E

Sponsor Name	Is Sponsor a WWP?	Project Name	Project Description	Capital Cost	Online Decade
ANTHONY	N	TOWN OF ANTHONY - ADDITIONAL GROUNDWATER WELL	CONVEYANCE/TRANSMISSION PIPELINE; NEW AGREEMENT; SINGLE WELL	$1,244,471	2020
ANTHONY	N	TOWN OF ANTHONY - ARSENIC TREATMENT FACILITY	CONVEYANCE/TRANSMISSION PIPELINE; NEW WATER TREATMENT PLANT; STORAGE TANK	$9,952,000	2020
ANTHONY	N	TOWN OF ANTHONY - WATER LOSS AUDIT AND MAIN-LINE REPAIR	CONVEYANCE/TRANSMISSION PIPELINE; WATER LOSS CONTROL	$759,000	2020
COUNTY-OTHER, BREWSTER	N	BREWSTER COUNTY OTHER (MARATHON WSSSERVICE) - WATER LOSS AUDIT AND MAIN-LINE REPAIR	CONVEYANCE/TRANSMISSION PIPELINE; WATER LOSS CONTROL	$426,000	2020
COUNTY-OTHER, BREWSTER	N	BREWSTER COUNTY OTHER (PANTHER JUNCTION BBNP PLT) - WATER LOSS AUDIT AND MAIN-LINE REPAIR	CONVEYANCE/TRANSMISSION PIPELINE; WATER LOSS CONTROL	$759,000	2020
COUNTY-OTHER, BREWSTER	N	BREWSTER COUNTY OTHER (RIO GRANDE VILLAGE BBNP) - WATER LOSS AUDIT AND MAIN-LINE REPAIR	CONVEYANCE/TRANSMISSION PIPELINE; WATER LOSS CONTROL	$607,000	2020
COUNTY-OTHER, HUDSPETH	N	HUDSPETH COUNTY OTHER (CITY OF SIERRA BLANCA - HUDSPETH CO. WCID #1) - ADDITIONAL TRANSMISSION LINE	CONVEYANCE/TRANSMISSION PIPELINE	$1,429,000	2020
COUNTY-OTHER, HUDSPETH	N	HUDSPETH COUNTY OTHER (DELL CITY) - BRACKISH GROUNDWATER DESALINATION FACILITY	NEW WATER TREATMENT PLANT	$1,299,000	2020
COUNTY-OTHER, HUDSPETH	N	HUDSPETH COUNTY OTHER (DELL CITY) - WATER LOSS AUDIT AND MAIN-LINE REPAIR	CONVEYANCE/TRANSMISSION PIPELINE; WATER LOSS CONTROL	$1,614,000	2020
COUNTY-OTHER, HUDSPETH	N	HUDSPETH COUNTY OTHER (FORT HANCOCK WCID) - WATER LOSS AUDIT AND MAIN-LINE REPAIR	CONVEYANCE/TRANSMISSION PIPELINE; WATER LOSS CONTROL	$292,000	2020
COUNTY-OTHER, HUDSPETH	N	HUSDPETH COUNTY OTHER (FORT HANCOCK WCID #1) - ADDITIONAL WELL AND RO TREATMENT FACILITY	NEW WATER TREATMENT PLANT; SINGLE WELL; CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION; EVAPORATIVE POND	$6,109,000	2020
COUNTY-OTHER, JEFF DAVIS	N	JEFF DAVIS COUNTY OTHER (TOWN OF VALENTINE) - ADDITIONAL GROUNDWATER WELL	CONVEYANCE/TRANSMISSION PIPELINE; SINGLE WELL	$402,808	2020
EL PASO	Y	EPWU - ADVANCED PURIFIED WATER AT THE BUSTAMANTE WWTP	CONVEYANCE/TRANSMISSION PIPELINE; INJECTION WELL; WATER TREATMENT PLANT EXPANSION; PUMP STATION	$94,096,000	2020
EL PASO	Y	EPWU - ADVANCED PURIFIED WATER AT THE HASKELL AND NW WWTPS	CONVEYANCE/TRANSMISSION PIPELINE; INJECTION WELL; PUMP STATION; WATER TREATMENT PLANT EXPANSION	$291,800,000	2040
EL PASO	Y	EPWU - BRACKISH GROUNDWATER AT THE JONATHAN ROGERS WWTP	CONVEYANCE/TRANSMISSION PIPELINE; INJECTION WELL; MULTIPLE WELLS/WELL FIELD; PUMP STATION; STORAGE TANK; WATER TREATMENT PLANT EXPANSION	$65,865,000	2040
EL PASO	Y	EPWU - EXPANSION OF LOCAL WELL FIELDS	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$32,712,000	2020
EL PASO	Y	EPWU - EXPANSION OF THE JONATHAN ROGERS WWTP	WATER RIGHT/PERMIT LEASE OR PURCHASE; WATER TREATMENT PLANT EXPANSION	$95,186,653	2020
EL PASO	Y	EPWU - EXPANSION OF THE KAY BAILEY HUTCHINSON DESAL PLANT	CONVEYANCE/TRANSMISSION PIPELINE; INJECTION WELL; MULTIPLE WELLS/WELL FIELD; STORAGE TANK; WATER TREATMENT PLANT EXPANSION	$37,200,000	2020
EL PASO	Y	EPWU - GROUNDWATER FROM DIABLO FARMS	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; NEW WATER TREATMENT PLANT; PUMP STATION; STORAGE TANK	$273,507,000	2050
EL PASO	Y	EPWU - GROUNDWATER FROM HUECO RANCH	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; NEW WATER TREATMENT PLANT; PUMP STATION	$155,858,000	2040
EL PASO	Y	EPWU - GROUNDWATER FROM SOUTHERN HUDSPETH COUNTY	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; NEW WATER TREATMENT PLANT; PUMP STATION; STORAGE TANK	$98,980,000	2020
EL PASO	Y	EPWU - GROUNDWATER FROM THE DELL CITY AREA	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; NEW WATER TREATMENT PLANT; PUMP STATION; STORAGE TANK	$257,901,000	2060
EL PASO	Y	EPWU - RECHARGE OF HUECO AQUIFER GROUNDWATER WITH TREATED SURFACE WATER	CONVEYANCE/TRANSMISSION PIPELINE; DIVERSION AND CONTROL STRUCTURE	$1,806,000	2020

Recommended Projects Associated with Water Management Strategies

Sponsor Name	Is Sponsor a WWP?	Project Name	Project Description	Capital Cost	Online Decade
EL PASO	Y	EPWU - RIVERSIDE REGULATING RESERVOIR	CANAL LINING; CONVEYANCE/TRANSMISSION PIPELINE; DIVERSION AND CONTROL STRUCTURE; NEW SURFACE WATER INTAKE; PUMP STATION	$93,526,200	2020
EL PASO	Y	EPWU - TREATMENT AND REUSE OF AGRICULTURAL DRAIN WATER	NEW CONTRACT; NEW WATER TREATMENT PLANT; STORAGE TANK	$41,679,000	2030
EL PASO COUNTY TORNILLO WID	N	EL PASO CO. TORNILLO WID - ADDITIONAL GROUNDWATER WELL AND TRANSMISSION LINE	CONVEYANCE/TRANSMISSION PIPELINE; NEW WATER TREATMENT PLANT; PUMP STATION; SINGLE WELL; STORAGE TANK	$1,726,000	2020
EL PASO COUNTY TORNILLO WID	N	EL PASO CO. TORNILLO WID - ARSENIC TREATMENT FACILITY	NEW WATER TREATMENT PLANT	$3,114,000	2020
FORT DAVIS	N	FORT DAVIS WSC - ADDITIONAL GROUNDWATER WELL	CONVEYANCE/TRANSMISSION PIPELINE; SINGLE WELL	$507,000	2020
FORT DAVIS	N	FORT DAVIS WSC - ADDITIONAL TRANSMISSION LINE	CONVEYANCE/TRANSMISSION PIPELINE	$1,068,000	2020
HORIZON REGIONAL MUD	Y	HORIZON REGIONAL MUD - ADDITIONAL WELLS AND EXPANSION OF DESAL PLANT	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; WATER TREATMENT PLANT EXPANSION	$56,443,000	2020
IRRIGATION, EL PASO	N	EL PASO COUNTY - EPCWID #1 - IMPROVEMENTS TO WATER DISTRICT DELIVERY SYSTEM	CANAL LINING; CONVEYANCE/TRANSMISSION PIPELINE; DIVERSION AND CONTROL STRUCTURE	$157,777,783	2020
IRRIGATION, HUDSPETH	N	HUDSPETH IRRIGATION - HCCRD #1 - ADDITIONAL GROUNDWATER WELLS	MULTIPLE WELLS/WELL FIELD	$173,000	2020
LOWER VALLEY WD	Y	LVWD - GROUNDWATER FROM PROPOSED WELL FIELD - HUECO BOLSON AQUIFER	CONVEYANCE/TRANSMISSION PIPELINE; INJECTION WELL; MULTIPLE WELLS/WELL FIELD; NEW WATER TREATMENT PLANT; PUMP STATION; STORAGE TANK	$41,070,000	2020
LOWER VALLEY WD	Y	LVWD - GROUNDWATER FROM PROPOSED WELL FIELD - RIO GRANDE ALLUVIUM AQUIFER	CONVEYANCE/TRANSMISSION PIPELINE; INJECTION WELL; MULTIPLE WELLS/WELL FIELD; NEW WATER TREATMENT PLANT; PUMP STATION; STORAGE TANK	$37,490,000	2020
LOWER VALLEY WD	Y	LVWD - SURFACE WATER TREATMENT PLANT AND TRANSMISSION LINES	CONVEYANCE/TRANSMISSION PIPELINE; NEW AGREEMENT; NEW SURFACE WATER INTAKE; NEW WATER TREATMENT PLANT; PUMP STATION	$34,080,000	2020
LOWER VALLEY WD	Y	LVWD - WASTEWATER TREATMENT AND ASR FACILITY	CONVEYANCE/TRANSMISSION PIPELINE; INJECTION WELL; NEW WATER TREATMENT PLANT	$18,108,000	2020
MARFA	N	CITY OF MARFA - ADDITIONAL GROUNDWATER WELL	SINGLE WELL; CONVEYANCE/TRANSMISSION PIPELINE	$1,143,000	2020
MINING, CULBERSON	N	CUBERSON COUNTY - ADDITIONAL GROUNDWATER WELL - WEST TEXAS BOLSONS AQUIFER	SINGLE WELL	$675,000	2020
MINING, CULBERSON	N	CULBERSON COUNTY - ADDITIONAL GROUNDWATER WELLS - RUSTLER AQUIFER	MULTIPLE WELLS/WELL FIELD	$608,000	2020
MINING, EL PASO	N	EL PASO COUNTY - MINING - ADDITIONAL GROUNDWATER WELLS	MULTIPLE WELLS/WELL FIELD	$969,000	2020
MINING, HUDSPETH	N	HUDSPETH MINING - ADDITIONAL GROUNDWATER WELL	SINGLE WELL	$449,000	2020
PRESIDIO	N	CITY OF PRESIDIO - ADDITIONAL GROUNDWATER WELL	CONVEYANCE/TRANSMISSION PIPELINE; NEW WATER TREATMENT PLANT; PUMP STATION; SINGLE WELL; STORAGE TANK	$1,861,000	2020
PRESIDIO	N	CITY OF PRESIDIO - WATER LOSS AUDIT AND MAIN-LINE REPAIR	CONVEYANCE/TRANSMISSION PIPELINE; WATER LOSS CONTROL	$2,172,000	2020
VAN HORN	N	CITY OF VAN HORN - WATER LOSS AUDIT AND MAIN-LINE REPAIR	CONVEYANCE/TRANSMISSION PIPELINE; WATER LOSS CONTROL	$1,197,000	2020
VINTON	N	CITY OF VINTON - HIGH CAPACITY WATER LINES	CONVEYANCE/TRANSMISSION PIPELINE	$4,192,000	2020

Region E Total Recommended Capital Cost	**$1,929,832,915**

***Projects with a capital cost of zero are excluded from the report list.**

Alternative Projects Associated with Water Management Strategies

Project Sponsor Region: E

Sponsor Name	Is Sponsor a WWP?	Project Name	Project Description	Capital Cost	Online Decade
MINING, TERRELL	N	TERRELL COUNTY MINING - ADDITIONAL GROUNDWATER WELLS	MULTIPLE WELLS/WELL FIELD	$738,000	2020

Region E Total Alternative Capital Cost	**$738,000**

***Projects with a capital cost of zero are excluded from the report list.**

Water User Group (WUG) Management Supply Factor

REGION E	WUG MANAGEMENT SUPPLY FACTOR					
	2020	2030	2040	2050	2060	2070
ALPINE	1.1	1.1	1.1	1.1	1.1	1.1
ANTHONY	6.8	5.8	5.1	4.6	4.1	3.8
CLINT	3.0	3.1	3.3	3.3	3.3	3.3
COUNTY-OTHER, BREWSTER	2.0	2.0	2.0	1.9	1.9	1.9
COUNTY-OTHER, CULBERSON	2.2	2.0	2.0	1.9	1.9	1.9
COUNTY-OTHER, EL PASO	1.0	1.0	1.0	1.0	1.0	1.0
COUNTY-OTHER, HUDSPETH	5.6	5.3	5.4	5.3	5.3	5.3
COUNTY-OTHER, JEFF DAVIS	4.4	4.5	4.7	4.7	4.8	4.8
COUNTY-OTHER, PRESIDIO	2.4	2.2	2.0	1.9	1.7	1.6
COUNTY-OTHER, TERRELL	3.2	3.2	3.2	3.2	3.2	3.2
EL PASO	1.4	1.3	1.4	1.4	1.4	1.4
EL PASO COUNTY TORNILLO WID	3.9	4.0	4.1	4.1	4.1	4.1
EL PASO WCID #4	1.3	1.3	1.4	1.4	1.3	1.3
FORT BLISS	1.1	1.1	1.1	1.1	1.1	1.1
FORT DAVIS	2.5	2.5	2.5	2.6	2.6	2.6
HORIZON CITY	1.1	1.0	1.0	1.0	1.0	1.0
HORIZON REGIONAL MUD	4.9	3.6	2.9	2.4	2.1	1.8
IRRIGATION, BREWSTER	1.4	1.4	1.4	1.4	1.4	1.5
IRRIGATION, CULBERSON	1.0	1.0	1.0	0.9	0.9	0.9
IRRIGATION, EL PASO	0.8	0.8	0.8	0.9	0.9	0.9
IRRIGATION, HUDSPETH	0.5	0.5	0.5	0.5	0.5	0.5
IRRIGATION, JEFF DAVIS	1.3	1.3	1.3	1.3	1.3	1.3
IRRIGATION, PRESIDIO	1.9	2.0	2.0	2.1	2.1	2.1
IRRIGATION, TERRELL	2.9	3.0	3.0	3.1	3.2	3.2
LIVESTOCK, BREWSTER	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, CULBERSON	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, EL PASO	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, HUDSPETH	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, JEFF DAVIS	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, PRESIDIO	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, TERRELL	1.0	1.0	1.0	1.0	1.0	1.0
LOWER VALLEY WD	7.8	6.6	5.8	5.1	4.7	4.3
MANUFACTURING, BREWSTER	1.0	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, EL PASO	1.0	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, HUDSPETH	5.0	5.0	5.0	5.0	5.0	5.0
MARFA	4.3	4.1	3.8	3.6	3.3	3.2
MINING, CULBERSON	2.8	1.1	1.0	1.3	1.7	2.2
MINING, EL PASO	1.4	1.2	1.1	1.0	1.0	1.0
MINING, HUDSPETH	1.1	1.1	1.1	1.1	1.0	1.0
MINING, PRESIDIO	1.0	0.0	0.0	0.0	0.0	0.0
MINING, TERRELL	0.3	0.3	0.3	0.4	0.5	0.6
PRESIDIO	5.6	5.4	5.2	4.9	4.6	4.4
SANDERSON	2.6	2.6	2.6	2.6	2.6	2.6
SIERRA BLANCA	5.6	5.2	5.1	5.0	5.0	5.0
SOCORRO	1.0	1.0	1.0	1.0	1.0	1.0
STEAM ELECTRIC POWER, EL PASO	1.0	1.0	1.0	1.0	1.0	1.0
VAN HORN	2.1	1.9	1.9	1.8	1.8	1.8
VINTON	3.2	3.1	3.1	3.0	2.9	2.8

Water User Group (WUG) Management Supply Factor

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. To calculate the Management Supply Factor for each WUG as a whole, not split by region-county-basin the combined total of existing and future supply is divided by the total projected demand.

`

Table of Contents

`

`

`

`

`

`

List of Tables

`

`

List of Figures

`

This page intentionally left blank.

CHAPTER 1

FAR WEST TEXAS DESCRIPTION

This page intentionally left blank.

1 FAR WEST TEXAS

Far West Texas encompasses the most arid region of the State of Texas. Residents of this expansive desert environment recognize that water is a scarce and valuable resource that must be developed and managed with great care to ensure the area's long-term viability. The Region's economic health and quality of life are dependent on a sustainable water supply that is equitably managed.

In January of 2011, the third round of regional water planning was concluded with the adoption of the *2011 Far West Texas Water Plan*. It is understood that this *Plan* was not a static plan but rather is intended to be revised as conditions change. For this reason, the current *2016 Plan* put forth in this document is not a new plan, but rather an evolutionary modification of the preceding *2011 Plan*. Only those parts of the previous *Plan* that require updating, and there are many, have been revised.

The purpose of the *2016 Far West Texas 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 inform all citizens of the importance of properly managing and conserving the delicate water resources of this desert community.

Chapter 1 presents a broad descriptive overview of Far West Texas including currently existing water management planning facilities and international water issues. This chapter also summarizes specific planning components that are presented in more detail elsewhere in this *Plan*, such as projected population and water demand and available water-supply sources to meet these anticipated demands. Also provided in this chapter is a listing of State and Federal agencies, universities, and private organizations that are involved in various aspects of water supply issues.

1.1 WATER PLANNING AND MANAGEMENT

1.1.1 Regional Water Planning

The *2016 Far West Texas 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 *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. There are no known conflicts between this *Plan* and plans prepared for other regions. Publicly available water plans of major agricultural, municipal and commercial water users were considered in the development of this *Plan*, primarily as they relate to Chapter 5 recommended water management strategies, Chapters 5 and 7 conservation and drought topics.

The Far West Texas Water Planning Group (FWTWPG) is a voluntary association comprised of voting and non-voting members whom represent a minimum of 11 water use categories. Since 1997, the planning group has been involved in a wide range of projects, programs and the development of the regional water plan. All meetings and activities of the FWTWPG met all requirements under the Texas Open Meetings Act.

Water supply availability under drought-of-record conditions is considered in the planning process to insure that water demands can be met under the most challenging hydrologic circumstances (Section 1.4). For surface water supplies, drought-of-record conditions relate to the quantity of water available to meet existing permits from the Rio Grande and the Pecos River as estimated by the TCEQ Rio Grande Water Availability Model (WAM). This *2016 Plan* has no impact on navigation on these surface water courses.

The availability of groundwater during drought-of-record conditions is based on the Modeled Available Groundwater (MAG) volumes 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). The GMA process is explained in more detail in Section 1.5 of this chapter. Groundwater availability volumes for parts of the Region where MAGs are not determined by the TWDB are calculated separately. Chapter 3 contains a detailed analysis of water supply availability in the Region.

Since the completion of the *2011 Far West Texas Water Plan*, a number of changed conditions have occurred in the Region which warrants this 2016 updated water *Plan*. The latest census (2010) is the new baseline for estimates of population and municipal/rural water demand projections. Groundwater and surface water availability models (GAMs and WAMs) have been developed as resource tools for use in evaluating water-supply source availability.

This current *Plan* continues to rely on environmental data on the more prominent watercourses in the Region as contributed by the Texas Parks & Wildlife Department, the National Parks Service, and the

Texas Nature Conservancy. This data was useful in the assessment and consideration of environmental flow needs, springs, and ecologically unique stream segments. Also of informational importance to the FWTWPG were the monthly *"Drought Watch on the Rio Grande"* updates furnished by the Texas AgriLife Research Center at El Paso and the U.S. Bureau of Reclamation.

The FWTWPG strongly encourages all entities to participate in the planning process so that their specific concerns can be recognized and addressed. The Group also encourages the participation of groundwater conservation districts and recognizes their management plans and rules. District management plans are specifically respected when establishing groundwater availability estimates.

Water quality is recognized as an important component in this 50-year water plan. Water supplies can be diminished or made more costly to prepare for distribution if water quality is compromised (Section 1.8). To insure 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 water quality impacts (Chapter 5), and recommendations (Chapter 8).

1.1.2 Interim Regional Water Supply Research Projects

Previous planning periods included studies that provided important scientific data or water strategy analysis that was beyond the normal range of regional planning activities, but provided important insight and accuracy to the overall planning process. Reports of the results of these studies listed below are available at the Rio Grande Council of Governments website (http://www.riocog.org/ENVSVCS/FWTWPG/docs.htm). Information gained from these projects is also incorporated in specific water-supply management strategies discussed in Chapter 5.

- Igneous Aquifer System of Brewster, Jeff Davis and Presidio Counties, Texas (2001)
- West Texas Bolsons and Igneous Aquifer System Groundwater Availability Model Data Collection (2003)
- Conceptual Evaluation of Surface Water Storage in El Paso County (2008)
- Far West Texas Climate Change Conference (2008)
- Groundwater Data Acquisition in Far West Texas (2009)
- Evaluation of Irrigation Efficiency Strategies for Far West Texas: Feasibility, Water Savings and Cost Considerations (2009)
- Water Conservation Conference for Far West Texas Water Plan Region E (2009)
- Groundwater Data Acquisition and Analysis for the Marathon and Edwards-Trinity (Plateau) Aquifers (2010)

1.1.3 State Water Plan

The Texas Water Development Board adopted *Water for Texas 2012* as the latest official Texas State Water Plan. 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 2012 State Water Plan is the third water plan to incorporate water management and policy decisions made at the regional level as expressed in the 16 approved regional water plans. The segment of the State Plan that addresses Far West Texas highlight:

- Additional supply needed in 2060 – 226,569 acre-feet per year
- Recommended water management strategy volume in 2060 – 130,526 acre-feet per year
- Total capital cost to implement all strategies - $842 million
- Conservation accounts for 40 percent of 2060 strategy volume
- Significant unmet irrigation needs
- Groundwater desalination accounts for 21 percent of 2060 strategy volume
- One additional unique stream segment recommended for designation

1.1.4 Groundwater Conservation Districts

The Texas Legislature has established a process for local management of groundwater resources through groundwater conservation districts. Groundwater conservation districts are charged to manage 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." Six districts are currently in operation within the planning region (Figure 1-1) and their management goals are discussed in further detail in Chapter 6.

- Brewster County Groundwater Conservation District
- Culberson County Groundwater Conservation District
- Hudspeth County Underground Water Conservation District #1
- Jeff Davis County Underground Water Conservation District
- Presidio County Underground Water Conservation District
- Terrell County Groundwater Conservation District

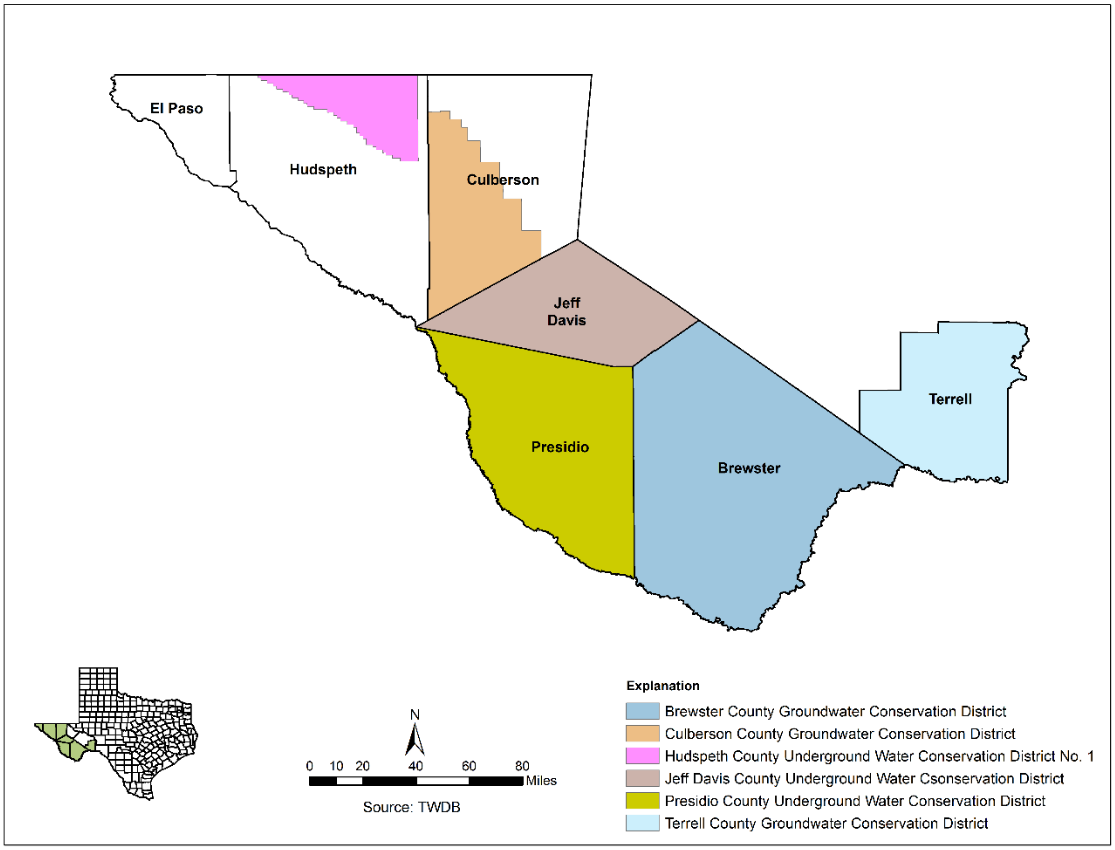


Figure 1-1. Groundwater Conservation Districts

1.1.5 Groundwater Management Areas

In recent sessions, the Texas Legislature has redefined the manner in which groundwater is to be managed (www.twdb.texas.gov/groundwater/management_areas). Senate Bill 2 of the 77th Texas Legislature (2001) authorized:

- The Texas Water Development Board (TWDB) to designate Groundwater Management Areas that would include all major and minor aquifers of the State.
- Required groundwater conservation districts to share groundwater plans with other districts in the Groundwater Management Area.
- Allowed a groundwater conservation district to call for joint planning among districts in a Groundwater Management Area.

The objective was to delineate areas considered suitable for management of groundwater resources. A Groundwater Management Area (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 (http://www.twdb.texas.gov/mapping/maps.asp).

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 groundwater conservation districts. The new requirements indicate 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."*

Desired Future Conditions (DFCs) are a description of the aquifers at some time in the future. This description is a precursor to developing a volumetric number called *Modeled Available Groundwater* (MAG). The TWDB is responsible for providing each groundwater conservation district and regional water planning group, located wholly or partly in the management area, with MAG volumes. Once the MAG is determined, the districts begin issuing groundwater withdrawal permits to support the desired future condition of the aquifer up to the total amount of MAG. These permits express DFCs by only allowing withdrawals that will support the conditions established by the groundwater management area. Regional water plans must also incorporate the MAG for each aquifer within their regions. The counties of Far West Texas are included in three Groundwater Management Areas:

- GMA 4 includes Brewster, Culberson, part of Hudspeth, Jeff Davis and Presidio
- GMA 5 includes El Paso and part of Hudspeth
- GMA 7 includes Terrell

This *2016 Far West Texas Water Plan* includes a significant revision to groundwater source availability estimates based on MAG volumes generated from the GMA process for those aquifers that are managed by the groundwater conservation districts.

1.1.6 El Paso Water Utilities/Public Service Board as the Declared Regional Water Supply Planner

In 1995, the Texas Legislature passed Senate Bill 450 designating the El Paso Water Utilities/Public Service Board as the regional water and wastewater planner for El Paso County. The purpose of the Bill is to improve regional water and wastewater planning for El Paso County and encourage increased consultation, coordination, and cooperation in the management of regional water resources. The City of El Paso serves a pivotal role in all future planning and expansion projects. The City, through the EPWU/PSB, receives priority consideration for public funding for the planning, design, and construction of water supply and wastewater systems within the County. The intent of Senate Bill 450 is to address regional planning issues by the following seven actions:

- Coordinate water and wastewater management on a regional watershed basis
- Address water quality and quantity conditions adversely affecting the public health and the environment
- Provide efficient planning and management of water resources to mitigate existing and avoid future negative colonia conditions
- Participate in water and wastewater planning with adjacent counties and the border states of New Mexico and Chihuahua, Mexico, to address transboundary water issues

- Encourage conjunctive management for the protection and preservation of the limited surface water and groundwater resources
- Maximize the amounts and provide for the efficient use of public funding to implement the purposes of Senate Bill 450
- Provide intergovernmental cooperation with water utilities to encourage their planning to be consistent with the regional plan

1.1.7 El Paso County Priority Groundwater Management Area

In 1985, the 69th Texas Legislature recognized that certain areas of the State were experiencing or were expected to experience critical groundwater problems. House Bill 2 directed the Texas Department of Water Resources (later to become the Texas Water Commission (TWC) and the Texas Water Development Board (TWDB)) to identify the "critical" groundwater areas in the State, to conduct studies in those areas, and to make recommendations on whether a groundwater conservation district should be established in critical areas. Senate Bill 1 changed the name of "Critical Area" to "Priority Groundwater Management Area" (PGMA) and mandated that the Texas Natural Resource Conservation Commission (TNRCC - successor agency to the TWC and later to be named TCEQ) complete reviews of all pending PGMA studies.

The Priority Groundwater Management Area (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 Groundwater Conservation District (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 Groundwater Management Area 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 regulating entity to address the identified groundwater issues. PGMAs are still relevant as long as there remain portions within these designated areas without GCDs. A statewide map of the declared PGMA areas is available at: http://www.tceq.state.tx.us/assets/public/permitting/watersupply/groundwater/maps/pgma_areas.pdf

The TWC and TWDB evaluated groundwater supply conditions in El Paso County in 1990 as part of the PGMA program. An overview evaluation (TWDB Report 324) recognized that the Hueco Bolson Aquifer had a long history of water-level decline and water-quality deterioration, and the expected life of the aquifer, under then current understanding, was about 60 years at best. However, rather than declaring the area "Critical," the TWC placed a moratorium over the declaration until after the completion of a 50-year City of El Paso water management plan.

The TNRCC requested a technical update study of El Paso County, which was completed in the spring of 1998 (TWDB Open-File Report, Preston, 1998; and TPWD Report, El-Hage and Moulton, 1998). The TWDB report concluded that water-level declines and quality deterioration are still present in the Hueco Bolson, but did not address El Paso's plans to remedy the problems and provide long-term management. The TPWD reported no known effect on wildlife as a result of water-level declines in the Hueco Bolson

Aquifer. TNRCC staff then completed their analysis and recommended to their Commissioners that the area identified by the TWDB as the Hueco Bolson Aquifer in El Paso County be declared a PGMA (TNRCC File Report, Musick, 1998). The Commissioners, subsequently, declared *"the area of El Paso County overlying the Hueco Bolson Aquifer, including its subcrops and outcrops"* as a Priority Groundwater Management Area. However, the Commissioners stated that,

> "El Paso has clearly demonstrated a significant effort toward regional cooperation, planning, and voluntary implementation of actions to address water supply problems" and that "it is not clear that creating a groundwater conservation district for the area of El Paso County overlying the Hueco Bolson Aquifer would be in the public interest, meet a public need, or benefit the property therein at this time" *(TNRCC Docket No. 98-0999-MLM, SOAH Docket No. 582-98-1540).*

Since the conclusion of this action, El Paso County Commissioner's Court has not promulgated any water availability requirements within the County.

1.1.8 Hudspeth County Priority Groundwater Management Area Consideration

In March 2005, Texas Commission on Environmental Quality (TCEQ) released a report titled Evaluation for the Hudspeth County Priority Groundwater Management Study Area. The purpose of this evaluation was to determine if the Hudspeth County area is experiencing, or is expected to experience within the next 25 years, critical groundwater problems, and whether a groundwater conservation district should be created to address such problems. The study area included all of Hudspeth County; however only the area outside of the Hudspeth County Underground Water Conservation District No. 1 was considered for Priority Groundwater Management Area (PGMA) designation.

For this report, TCEQ staff considered comments, data, and information provided by a number of different sources including water stakeholders from within the study area, the TWDB, the TPWD, the FWTWPG, and independent research by the staff. The report discusses the available authority and management practices of existing groundwater management entities within and adjacent to the study area, and makes recommendations on appropriate strategies needed to conserve and protect local groundwater resources.

The water supply problems identified in the study area include widespread total dissolved solids concentrations in groundwater and the lack of firm alternative supplies for irrigation use in the Rio Grande Valley during drought-of-record conditions. Groundwater concerns expressed by area stakeholders included sustainability, water quality, availability, access to alternative water supplies, and the possibility of water exportation.

The TCEQ concluded that the identified water supply and water quality issues are not presently critical problems and are not anticipated to be critical during the next 25-year planning horizon, and that the Hudspeth County study area should not be designated as a PGMA at this time. However, the TCEQ also acknowledges that the creation of a groundwater conservation district is a feasible and practicable groundwater management option for citizens of the study area to consider.

1.2 FAR WEST TEXAS GEOGRAPHIC SETTING

Located in the westernmost region of the State, Far West Texas is bounded on the north by New Mexico, on the south and west by the Rio Grande and the United Mexican States, and on the east by the Pecos River; and incorporates the counties of Brewster, Culberson, El Paso, Hudspeth, Jeff Davis, Presidio and Terrell (Figure 1-2). These counties claim some of the most impressive topography and scenic beauty in Texas. The Region is home to the Guadalupe Mountains National Park, Big Bend National Park, and the contiguous Big Bend Ranch State Park. El Paso, the largest city in the Region, is also the nation's largest city on the U.S.-Mexico border. Ciudad Juarez, with an estimated population of over 1.5 million, is located across the Rio Grande from the City of El Paso and shares the same water sources with El Paso.

All seven counties that comprise the planning Region lie solely within the Rio Grande River Basin. The Rio Grande not only forms the border between the United States and Mexico but is also a vital water-supply source for communities, industries, and agricultural activities adjacent to the River. Above Fort Quitman, use of water from the Rio Grande is controlled primarily by the operations of the Rio Grande Project, which was established to supply agricultural water in southern New Mexico and Far West Texas. Other than along the Rio Grande corridor, the Region is dependent on groundwater resources derived from several aquifer systems.

The counties of Far West Texas are among the largest in the State, occupying 24,069 square miles (mi^2), or 9 percent of the total State area. Ranked by total area, the counties that make up the Region are Brewster (6,193 mi^2), Hudspeth (4,572 mi^2), Presidio (3,856 mi^2), Culberson (3,813 mi^2), Terrell (2,358mi^2), Jeff Davis (2,264 mi^2), and El Paso (1,013 mi^2).

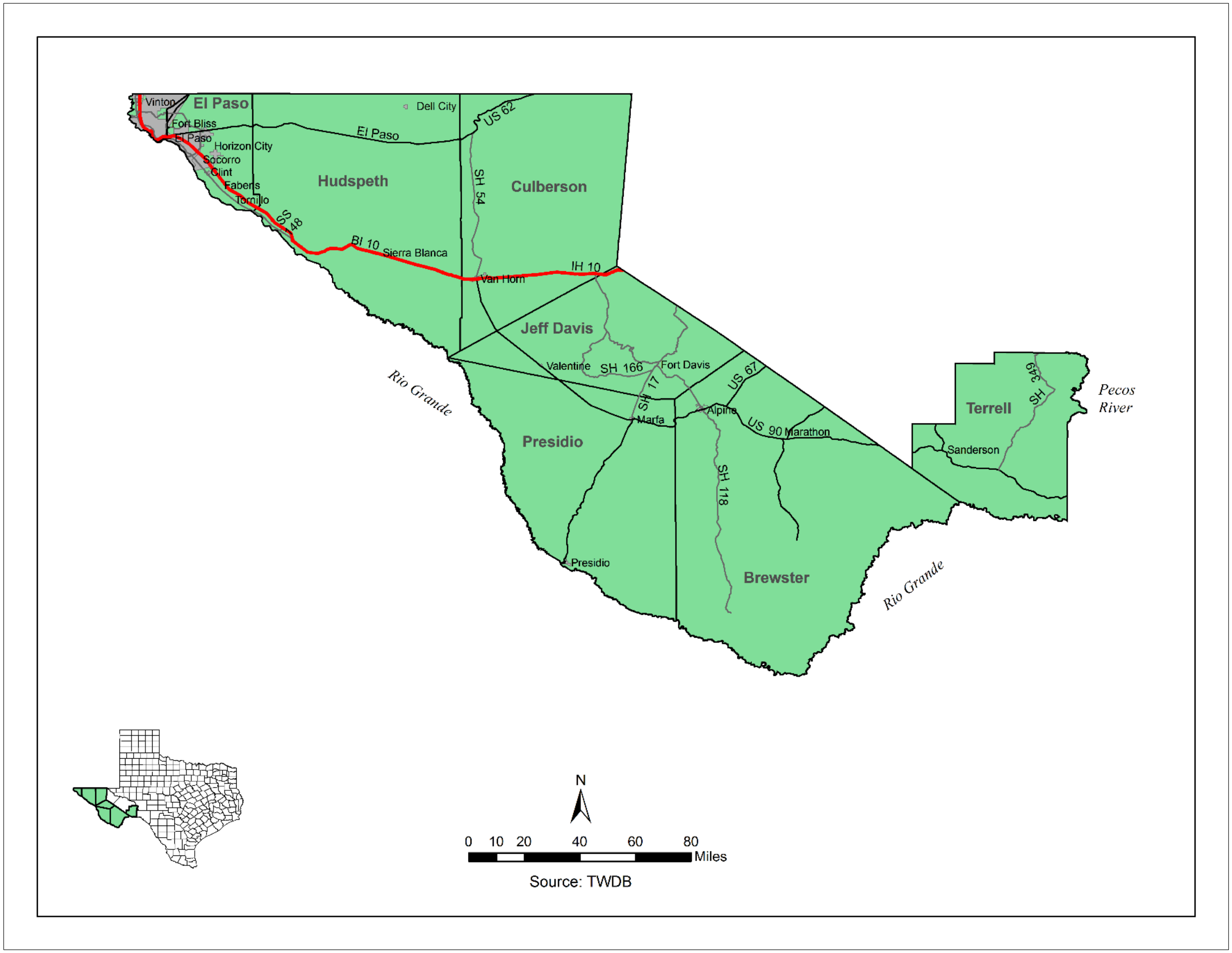


Figure 1-2. Regional Location

1.2.1 Physiography

Far West Texas is located in a topographically distinct area of North America known as the Basin and Range Physiographic Province and is characterized by higher elevations and greater local relief than is observed anywhere else in the State. Traversed from north to south by an eastern range of the Rocky Mountains, the Region contains all of Texas' true mountains (Figure 1-3). Widely spaced mountain ranges rise from 1,000 to more than 3,000 feet above the intervening basin lowlands.

Although most of Texas is generally flat and less than 2,500 feet above mean sea level, the floors of most of the basins in Far West Texas are at elevations greater than 3,000 feet. The basins (or bolsons) are filled with sediments eroded from the surrounding mountains. At the deepest points of the basins, deposits of basin-fill range in thickness from less than 1,000 feet to more than 9,000 feet. With the exception of the Rio Grande and its tributaries, the Rio Conchos (Chihuahua, Mexico) and the Pecos River (Texas), all surface water in the Region drains toward the lowest elevation within each basin. "Salt Flats" occur in northeastern Hudspeth and northwestern Culberson Counties where water, upwelling from shallow aquifers and collecting from rainfall runoff, rapidly evaporates leaving behind accumulations of mineral deposits. These lakes are dry during periods of low rainfall, exposing salt-incrusted basin flats. For years, this area was a source of commercial salt extraction.

Highest of the mountain ranges are the Guadalupe Mountains, which straddle the Texas-New Mexico state line. The range comes to an abrupt end about 20 miles south of the Texas-New Mexico border, where Guadalupe Peak (the highest surface elevation in Texas at 8,751 feet) and El Capitan overlook the Salt Basin to the west and south. Lying west of the Salt Basin and extending to the Hueco Mountains a short distance east of El Paso is the Diablo Plateau.

Other mountain ranges, including the Eagle, Quitman, Carrizo, Delaware, and Sierra Vieja Mountains, are located south and east of the Diablo Plateau in Culberson, Hudspeth, Jeff Davis, and Presidio Counties. These mountains overlook several intermountain basins from which there is no external drainage (e.g., Eagle Flat, Ryan Flat, Michigan Flat, and Wild Horse Flat). Two other basins, Red Light Draw and Green River Valley, are dissected by and drain to the Rio Grande.

The Davis Mountains are principally in Jeff Davis County; however, igneous rocks originating from volcanic vents that formed the Davis Mountains extend into Brewster, Hudspeth, and Presidio Counties. The Davis Mountains contain a number of peaks with elevations greater than 7,000 feet, including Mount Livermore, which at 8,206 feet is one of the highest peaks in Texas. Mount Locke at 6,809 feet is home to the University of Texas McDonald Observatory. These mountains intercept moisture-bearing winds and receive more precipitation than other locations in West Texas. The Davis Mountains are greener than other mountains of the Region with the growth of grass and forest trees.

The Big Bend country, which lies southeast of the Davis Mountains, is bounded on three sides by a great eastward swing of the Rio Grande, which gives it its name. It is a sparsely populated mountainous country with scant rainfall. Its principal mountains, the Chisos, rise to an elevation of 7,825 feet. Along the Rio Grande are the Santa Elena, Mariscal, and Boquillas Canyons, with rim elevations of 3,500 feet to 3,775 feet. Because of its remarkable topography and plant and animal life, the southern part of this region along the Rio Grande is home to Big Bend National Park and Big Bend Ranch State Park.

In El Paso County, the Franklin Mountains rise 3,000 feet above the adjacent Rio Grande valley floor to an elevation of 7,192 feet, and separate the “Upper and Lower Valleys” of the Rio Grande, as well as the Mesilla and Hueco Bolsons. The historic towns and missions of Ysleta, Socorro and San Elizario are located along the Lower Valley.

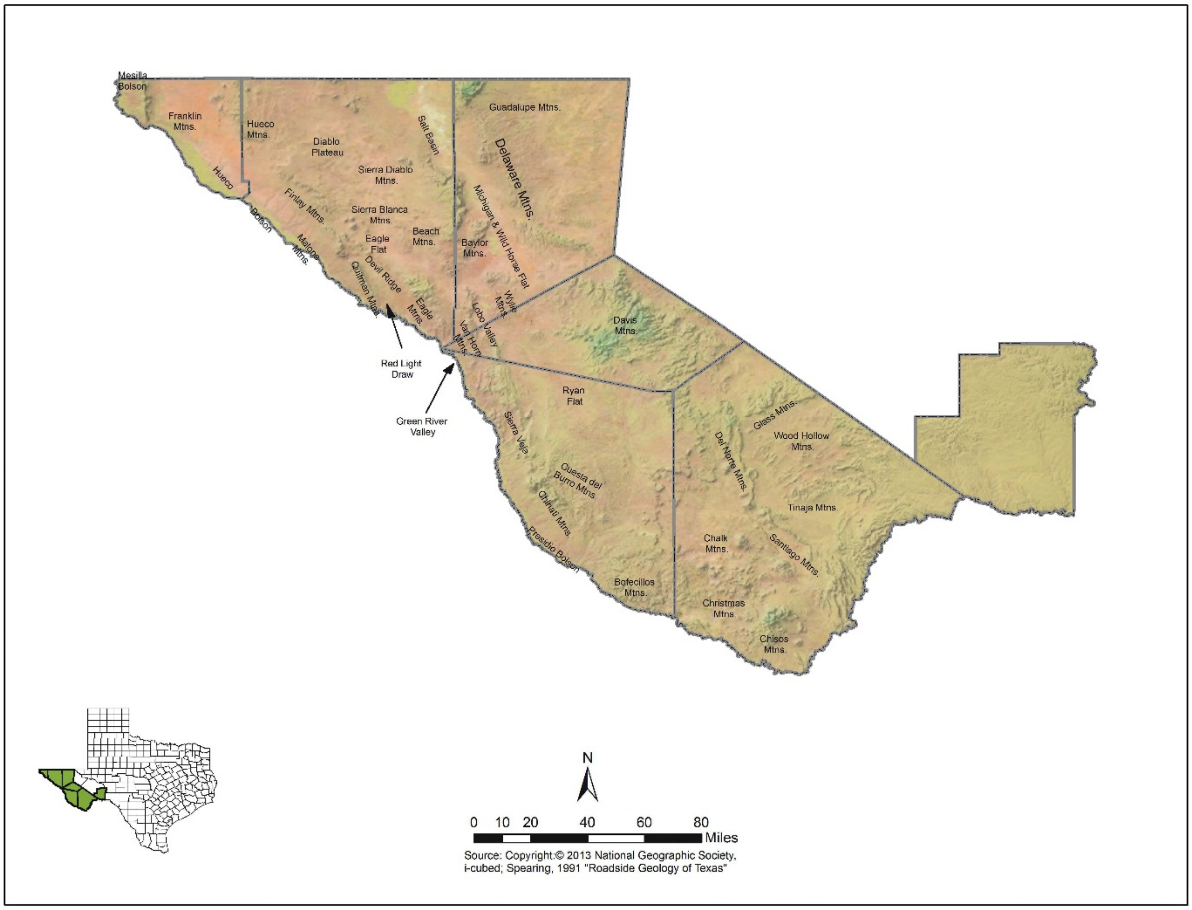


Figure 1-3. Mountains and Basins

1.2.2 Population and Regional Economy

With the exception of El Paso County, the counties of Far West Texas are among the least populated in the State. In the year 2020, approximately 97 percent (925,565) of the Region's 954,035 residents are projected to reside in El Paso County, where the population density is 914 persons per square mile (Figure 1-4). The population density of the six rural counties is approximately one person per square mile. Approximately 75 percent of the residents in the Region are Hispanic or Latinos.

The City of El Paso, one of the fastest growing cities in Texas, is the largest city in the Region, with a year-2020 projected population of 734,031. This is 79 percent of the total population of El Paso County and 77 percent of the Region's total population.

The year-2020 projected populations of cities in the six rural counties are as follows: Alpine, Brewster County (6,066); Van Horn, Culberson County (2,319); Sierra Blanca, Hudspeth County (620); Fort Davis, Jeff Davis County (1,264); Marfa, Presidio County (2,203); Presidio, Presidio County (4,867); Sanderson, Terrell County (889). Population of other smaller communities such as Fort Hancock, Del City, Marathon and Valentine are included in the "County Other" (rural) population of each county. The "County Other" rural population of the Region is 48,664, or five percent of the total Regional population. The current and projected population growth in Far West Texas is further discussed in Chapter 2.

The regional economy is predominantly comprised of agriculture, agribusiness, manufacturing, tourism, wholesale and retail trade, government, and military. According to TWDB's socio-economic analysis (provided in Appendix 6A), the Far West Texas Regional economy generates about $35 billion in gross state product for Texas and supports 406,000 jobs.

The dominant commercial land use throughout the rural areas of the Region is extensive cattle grazing. Aridity and historic land-tenure practices have combined to produce large ranches and low animal densities. Dairy operations in El Paso County represent the largest proportion of the market valuation for livestock, as El Paso County traditionally ranks in the top five dairy-production counties in Texas. Floodplain-irrigated agriculture is found along the Rio Grande extending above and below El Paso and into southern Hudspeth County. A much smaller irrigated strip also occurs along the River near Presidio. Currently, irrigated agriculture based on groundwater pumping is essentially limited to Dell Valley in northeastern Hudspeth County, Diablo Farms in northwestern Culberson County, and Wild Horse and Lobo Flats near Van Horn.

An innovative agricultural industry has developed in Jeff Davis and Presidio Counties where large greenhouse facilities have been constructed and successfully operated for the production of hydroponically grown tomatoes. The Jeff Davis County and Presidio County Underground Water Conservation Districts permit well use for these two facilities and thus have records of their annual groundwater use. Although small compared to large-scale farming operations elsewhere in the Region, the Districts do strive to insure that this innovative industry is recognized in the Regional Water Plan.

The new Tornillo-Guadalupe International Bridge border crossing in El Paso County was completed in 2014 and replaces the existing Fabens-Caseta International Bridge. The crossing, capable of handling modern day commercial, automobile and pedestrian traffic, supports the expansion of trade and economic growth on both sides of the border. In the El Paso area the new crossing allows continued expansion of jobs in related industries such as trucking, warehousing, transshipping, and manufacturing; and according to the border economic plan for El Paso County also allows expansion of employment opportunities along IH-10 near the intersection of traffic from Tornillo and Fabens. In Mexico, the project provides an additional crossing that accommodates the expansion of maquiladora plants eastward from Juarez. By 2025, total annual vehicle crossings, both north and south, are expected to be over 900 thousand. Commercial truck traffic that previously traveled through downtown El Paso and Juarez is now able to move through the new crossing beyond the congested urban core, thus reducing air and noise pollution.

In the past several years, the Barnett Shale play has become the largest natural gas play in the State of Texas. This productive geologic formation has equivalent rock units (Woodford) that extend into West Texas. Although gas production from these formations in West Texas have not generally proven to be as prolific as those in the Fort Worth area, exploration interest has caused water planners to pay attention to an industry with potential high water needs. In a concerted effort to derive meaningful water use estimates for all mining applications, including the oil and gas industry, a TWDB report (*Current and Projected Water Use in the Texas Mining and Oil and Gas Industry, 2011 and 2012*) estimates water use for mining, (which includes water used for drilling operations such as rig supply), water flooding, and fracking in two reports. These estimates determined a water use volume per oil and gas well. Estimates from these reports indicate that Culberson and Terrell Counties had the greatest demand by the oil and gas industry within the Far West Texas Region. None of the other counties in the Region have reported any significant usage by the industry.

It was estimated that 1,507 acre-feet of water were used in Culberson County and 191 acre-feet were used in Terrell County in 2008 by the industry for all oil and gas uses. To compare exploration between 2008, when these estimates were derived, to current conditions, Railroad Commission of Texas (RCT) oil well counts were reviewed. According to RCT oil well counts, there were 302 and 23 wells in Culberson and Terrell Counties in September 2014, respectively. In September 2008, there were 224 and 20 active rigs, respectively. This indicates that rig counts and the associated water use by the industry continue to slowly increase in these counties.

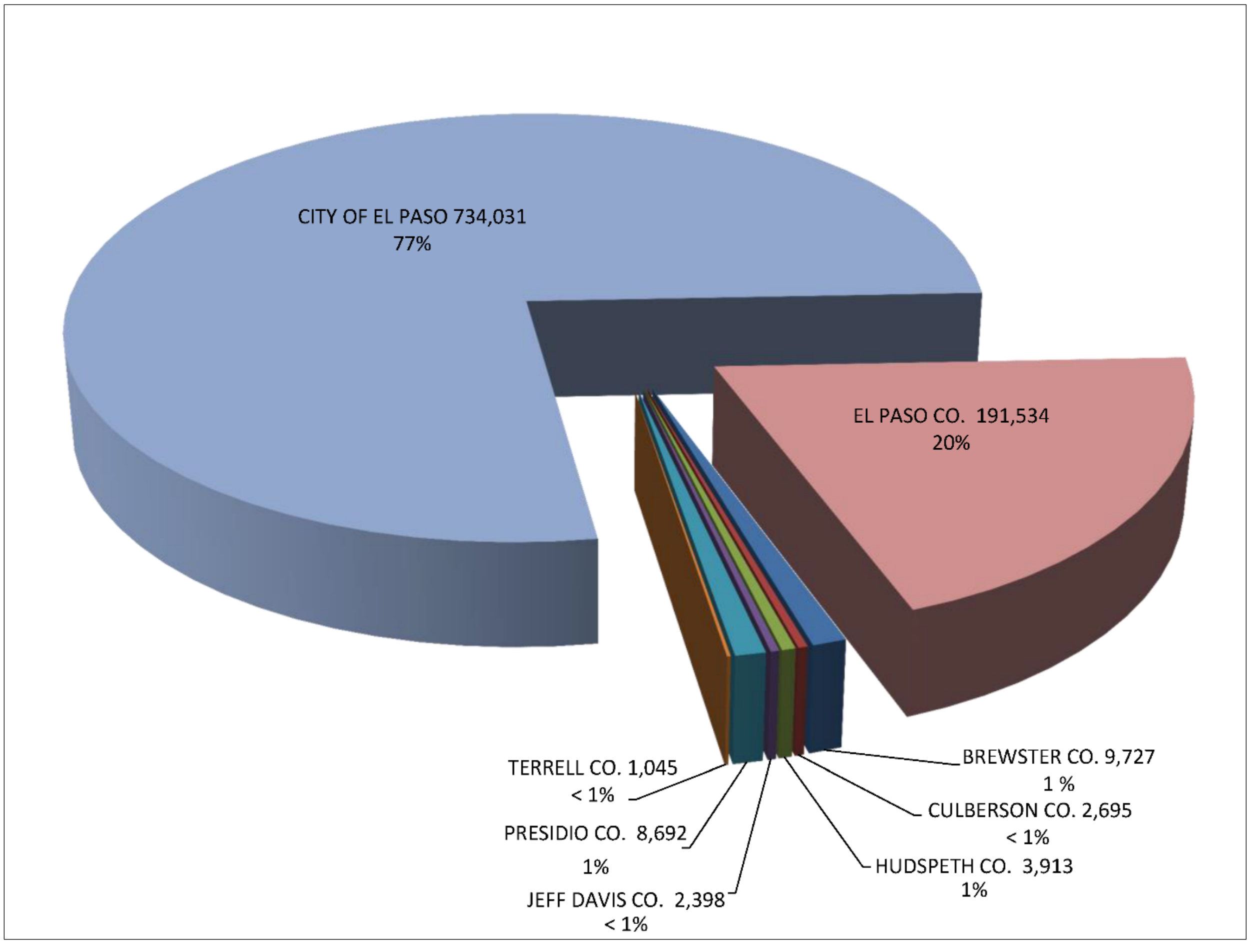


Figure 1-4. Year 2020 Projected Population

1.2.3 Land Use

Land use in the seven-county Region, as illustrated in Figure 1-5, is described here in terms of six categories:

- Urban (or developed)
- Cultivated agricultural
- Rangeland
- Forest
- Waterways and Wetlands
- Barren

Urban lands make up less than one percent of the total land area in Far West Texas. The largest concentration of urban land is in El Paso County, where 97 percent of the Region's residents live. Cultivated agricultural lands are identified as areas that support the cultivation of crops and occupy less than one percent of the total land area of the Region. These lands generally require access to high volumes of groundwater or surface water. Together, urban and cultivated agricultural lands comprise the two most significant water consumptive land-use areas.

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 the Region, rangeland accounts for one of the smallest sources of water demand. Forestland occurs where topography and climate support the growth of native trees. These are limited to highlands, such as the Davis, Guadalupe and Chisos Mountains. Forestlands rely exclusively on rainfall as a source of moisture.

Areas designated as either water or wetlands are mostly associated with the Rio Grande and the Pecos River and their tributaries. The Rio Grande is also a major source of irrigation water for agricultural lands in El Paso, Hudspeth and Presidio Counties. Most all other streams in the Region are ephemeral. In addition to the two rivers, wetlands formed by desert springs (cienegas) provide critical wildlife habitat. Finally, barren lands are defined as undeveloped areas with little potential for use for agriculture, rangeland, or forests.

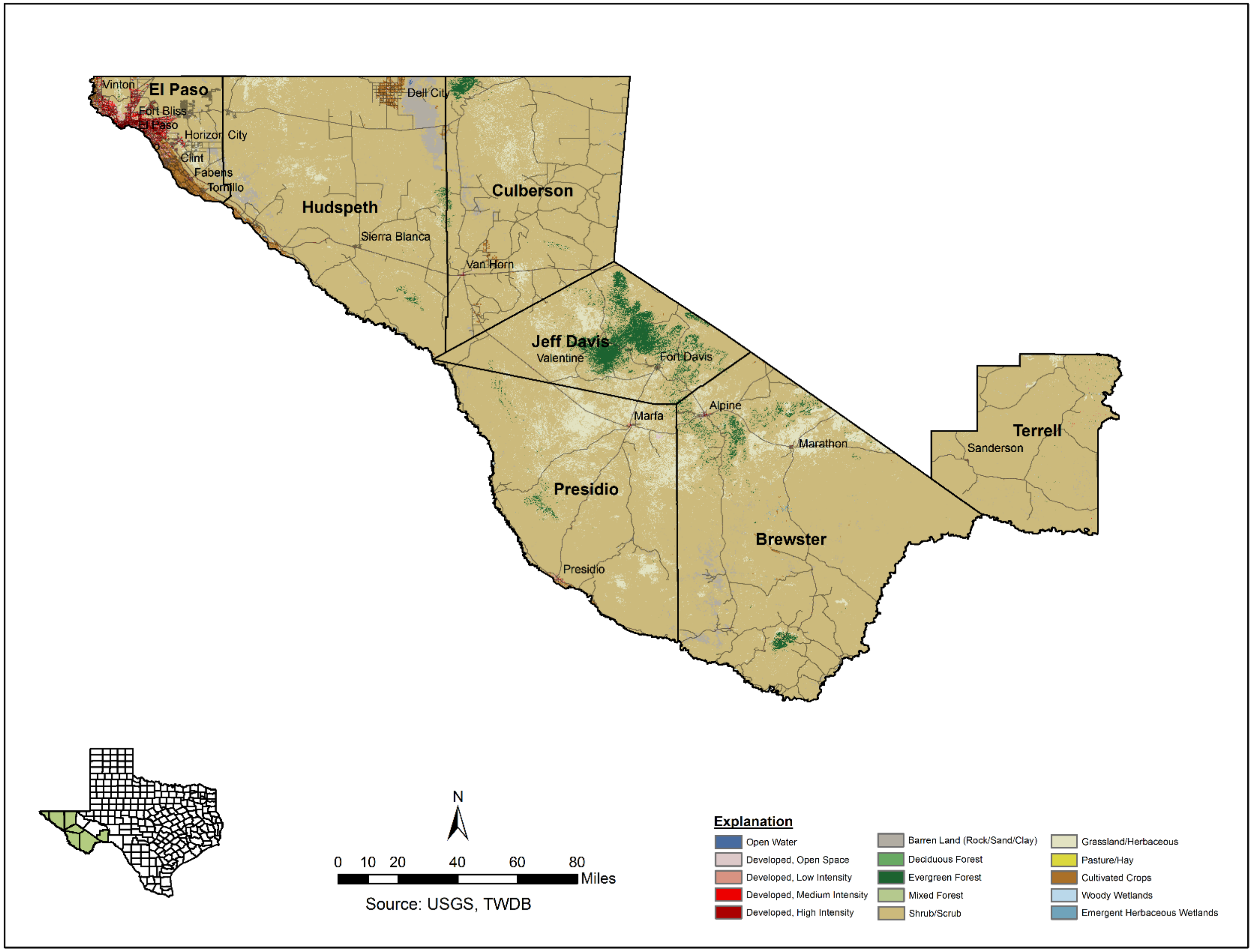


Figure 1-5. Land Use

1.2.4 Climate

Far West Texas, the most arid region in the State, is positioned in the northern part of the Chihuahuan Desert, a large arid zone that extends southward into Mexico. Only the highest altitudes occurring in the eastern part of the Region receive sufficient precipitation to be considered semiarid, rather than true desert.

The mean annual temperature of the Region is approximately 65° F. The average annual low temperature ranges between 45° F and 54° F, and the average high is 77° F to 80° F. During summer months, afternoon temperatures often exceed 100° F. In the winter, lows in the mountains and high desert plateaus can plummet to less than 10°F.

The Region usually reports the lowest annual precipitation (the regional average is 12.9 inches) and the highest lake-surface evaporation (the regional average is 70 inches) in Texas (Figure 1-6 and 1-7). The combination of low rainfall and high evaporation creates what would be considered drought conditions in any other part of the State.

From highest to lowest values, average annual rainfall at selected locations is reported as follows:

- Mount Locke, Jeff Davis County (20.8 in)
- Alpine, Brewster County (16.9 in)
- Marfa, Presidio County (15.9 in)
- Sanderson, Terrell County (14.3 in.)
- Van Horn, Culberson County (13.1 in)
- Presidio, Presidio County (10.8 in)
- Hudspeth County (10 in)
- City of El Paso, El Paso County (8.8 in)

According to the National Climatic Data Center, most rainfall occurs between the months of June and October, as indicated by a graph of average monthly rainfall for selected stations (Figure 1-8). 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.

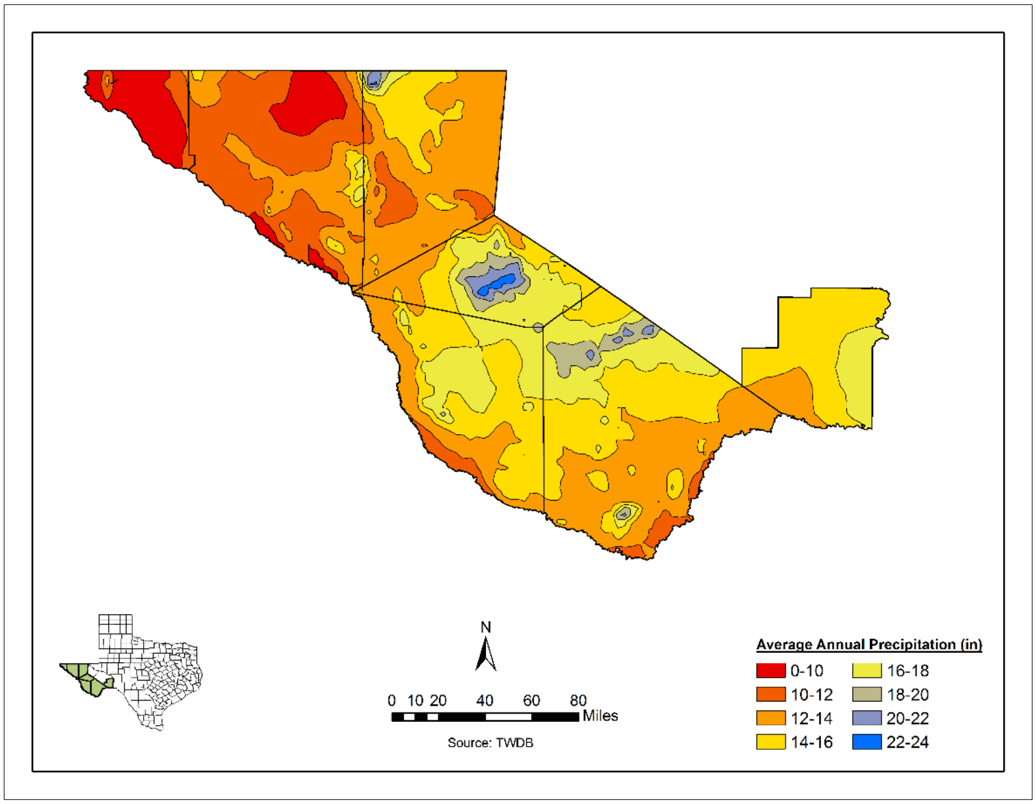


Figure 1-6.Variation of Precipitation

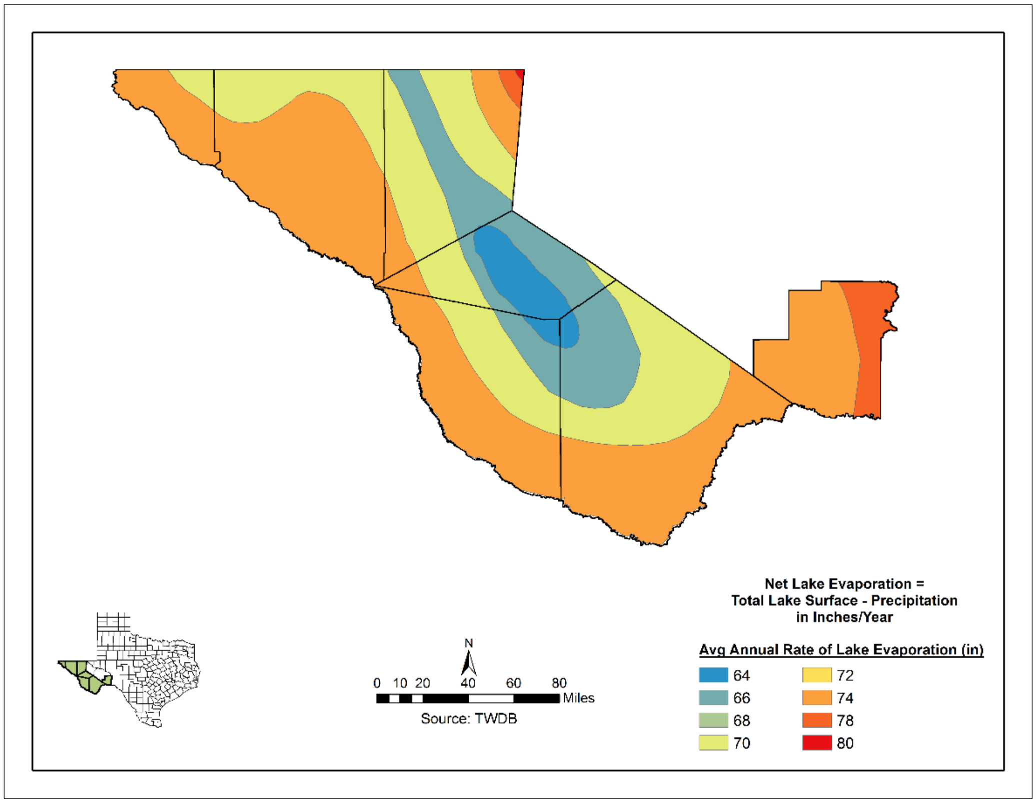


Figure 1-7. Net Lake Evaporation

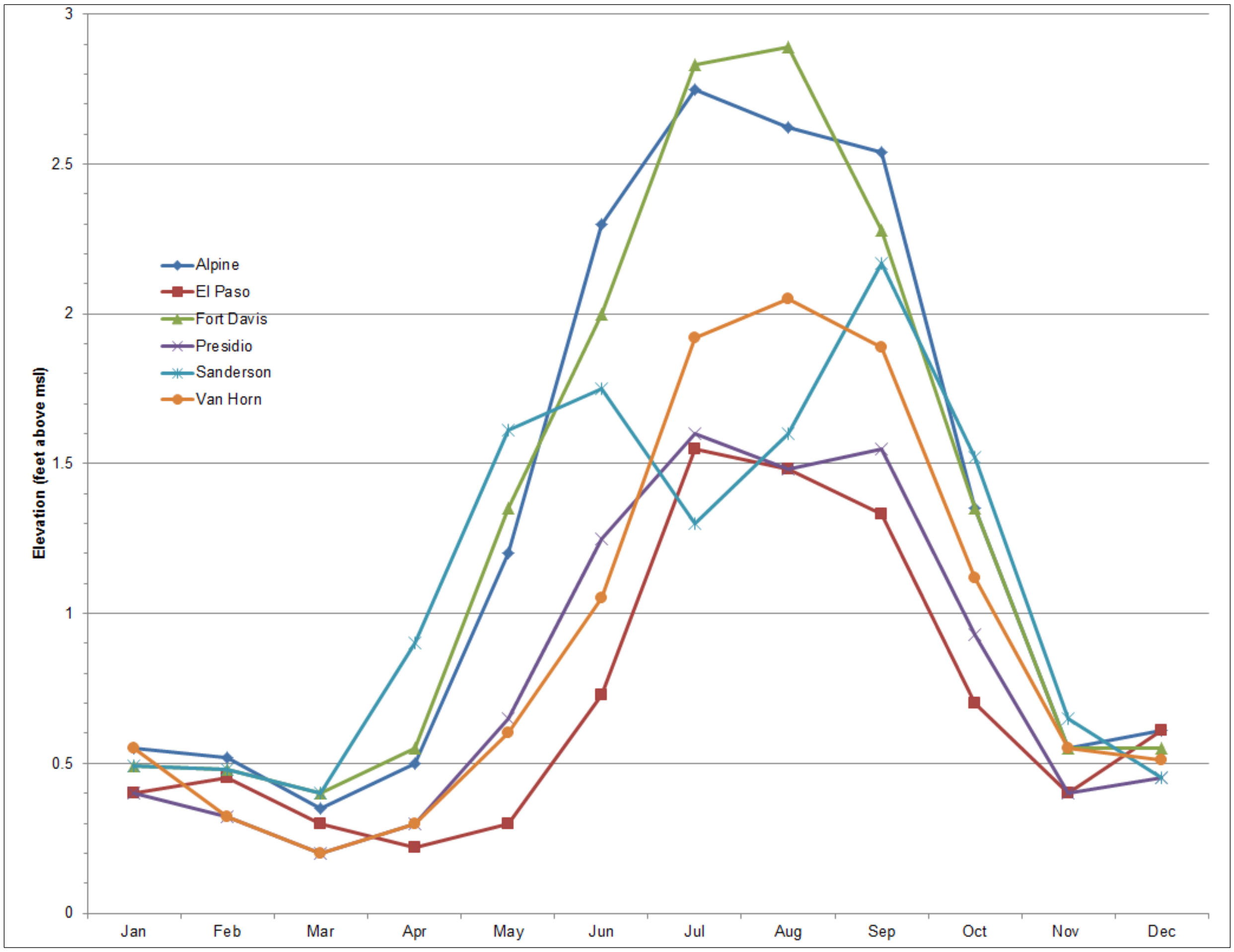


Figure 1-8. Average Monthly Rainfall

1.2.5 Far West Texas Climate Change Conference

Far West Texas, like much of the western United States, has historically relied on large-scale infrastructure to store and deliver surface water supplies. These surface water supplies are particularly vulnerable to changes in weather patterns. With the realization that the regional climate may have been more variable in the past than indicated by the historical record and may be even harsher and more variable in the future, a number of western states have taken on initiatives to address the potential impacts of climate change on their natural resources.

Because of these and other considerations, State Senator Eliot Shapleigh authored Senate Bill 1762 during the 80th Texas Legislative Session. The bill directed the Texas Water Development Board, in coordination with the FWTWPG, to conduct a study regarding the possible impact of climate change on surface water supplies from the portion of the Rio Grande in Texas subject to the Rio Grande Compact. As a result of this legislation, the Texas Water Development Board hosted the Far West Texas Climate Change Conference June 17, 2008, at the Carlos M. Ramirez Water Resources Learning Center in El Paso. Along with a number of other related issues, conference participants reviewed

- Current analyses of potential impacts of climate change on surface water resources in Texas and other Western states; and
- Recommendations for incorporating potential impacts of climate change into the Far West Texas Water Plan, including potential impacts to the Rio Grande in Texas subject to the Rio Grande Compact, and identifying feasible water management strategies to offset any potential impacts.

The entire report "Far West Texas Climate Change Conference – Study Findings and Conference Proceedings" can be accessed at http://www.twdb.texas.gov/publications/reports/special_legislative_reports/doc/climatechange.pdf.

1.2.6 Drought

Drought conditions are assumed in the planning process to insure that adequate infrastructure and planning is in place under severe water shortage conditions and is discussed in detail in Chapter 7 of this *Plan*. Drought in Far West Texas 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 springflow or streamflow.

Although agricultural drought and hydrologic drought are consequences of meteorologic drought, the occurrence of meteorologic drought does not guarantee that either one or both of the others will develop. With regard to the upper segment of the Rio Grande, drought is more significantly influenced by the amount of snowmelt in southern Colorado and northern New Mexico that affects the amount of water in storage in Elephant Butte Reservoir shown in Figure 1-9 (data provided by U.S Department of Interior, Bureau of Reclamation). For Far West Texas and particularly those who rely on the Rio Grande, an operational drought definition is more appropriate.

River drought above Fort Quitman is a period when the Rio Grande and its storage facilities (reservoirs) have reached a stage where water deliveries are less than full allocation. There may be a drought in all other definitions, but if there is adequate storage in the local reservoir (Elephant Butte), there is no “river drought” and no reduction in surface water deliveries.

River drought below confluence of Rio Conchos may be defined as any time the combined flows of the Rio Grande and Rio Conchos falls below 250 cubic feet per second (cfs) for more than 90 consecutive days.

Consistent flows of less than 250 cfs below Presidio have reduced to bare remnants an agricultural economy on land that has been continuously cultivated longer than anywhere else in Texas. Consistent low water flow threatens important wildlife habitat and river recreation resources that are essential building blocks for rural economies downstream of El Paso.

The westernmost part of Texas, as well as the headwaters of the Rio Grande in Colorado and New Mexico, has been experiencing drought conditions for much of the past two decades, with only 1997, 2005 and 2008 experiencing above average spring runoff into Elephant Butte reservoir. According to the U.S. Bureau of Reclamation El Paso Office, July 2013 Elephant Butte reservoir was at only three percent of capacity and 2013 was the shortest irrigation season (less than six weeks) and supplied the least amount of water in the almost 100 year history of the Rio Grande Project. Due to unusually heavy rainfall in September and early snowpack runoff because of warmer than normal temperatures in the spring of 2014, water storage in Elephant Butte and Caballo reservoirs increased to 402,778 acre-feet or 18 percent of the combined storage capacity of 2.23 million acre-feet. According to the TWDB Water Data for Texas (http://www.waterdatafortexas.org/), November 2015 Elephant Butte Reservoir is 10 percent of a full reservoir. Approximately one-fourth of the water currently in storage is Rio Grande Compact Credit water, which is owned by upstream users and is not available for use in southern New Mexico, Texas, or Mexico.

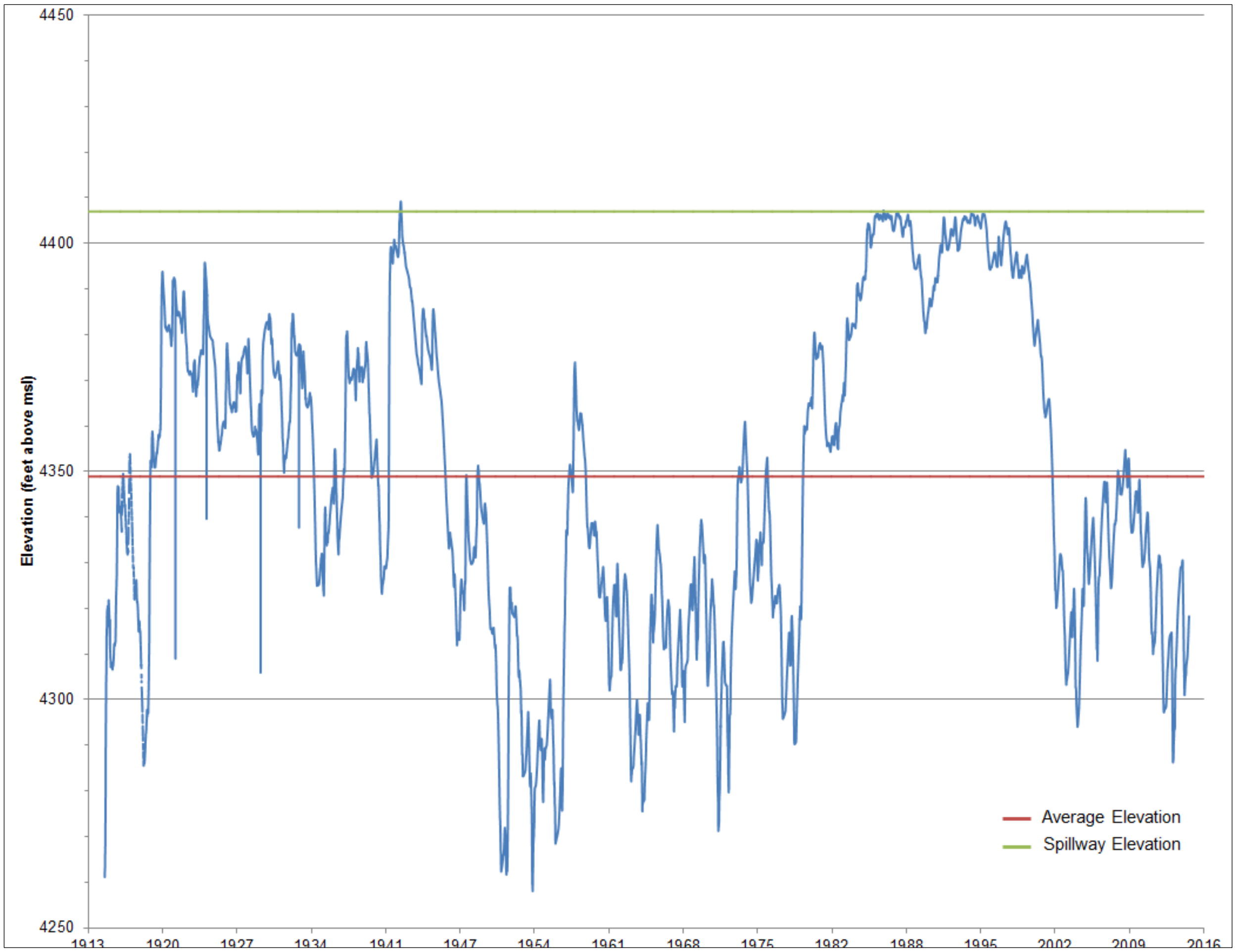


Figure 1-9. Elephant Butte Reservoir

The 1950s Drought of Record (DOR) and the current drought can be compared using historic precipitation, stream flow records, spring discharges and water level measurements in wells for locations that have accumulated data measurements since the 1940s. This is discussed further in Chapter 7 Section 7.2. For the purpose of this planning cycle, the drought of the 1950s is declared the DOR. However, it is the intent of the current *2016 Plan*, to illustrate in Chapter 7 that although the 1950s drought is the Historic Drought of Record, the current drought is significant. Although it is impossible at this time to determine whether the current drought will become the new DOR, further evaluations will be made in future planning cycles to continuously assess the Region's drought conditions.

Far West Texas is perennially under drought or near-drought conditions compared with more humid areas of Texas. Although residents of the Region are generally accustomed to these conditions, the 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. Those entities that rely on surface water are most vulnerable to the impact of drought. Irrigators along the Rio Grande rely on projected allocations provided by the U.S. Bureau of Reclamation to anticipate their crop potential each year. El Paso Water Utilities has developed a conjunctive use plan in which it can shift supply emphasis to groundwater sources during periods of low surface water availability. Water management and drought contingency plans for regional entities are discussed in detail in Chapter 7 Section 7.3

1.2.7 Native Vegetation and Ecology

Vegetation native to the arid Chihuahuan Desert is closely tied to the Region's precipitation and evaporation potential. This area typically receives most of its precipitation in the summer in the form of convective storms, which are typically characterized by intense rainfall concentrated in small areas. When it occurs, winter precipitation comes from frontal systems, which are generally soaking rains covering larger areas. Due to their nature, the summer precipitation generally wets only the shallow subsurface soil layer, whereas, winter rains are more likely to percolate deeper into the subsurface.

According to the Chihuahuan Desert Research Institute, vegetation native to Far West Texas can be classified into two groups, intensive water users and extensive water users. Intensive water users include short grasses and cacti, which have short root systems and respond quickly to small amounts of moisture that is available in the soil profile for only a limited time. Extensive water users have both shallow roots capable of capturing soil moisture as well as deep roots that penetrate further downward in the subsurface. Thus, summer rainfall favors grasslands, while winter rainfall favors scrubs. Although a shift in predominate precipitation patterns from summer to winter has not been clearly recognized, local observations indicate that scrubs are becoming more predominate. Likewise, it is becoming increasingly clear that ongoing drought conditions in Far West Texas are placing a serious strain on vegetation, especially the oak and conifer woodlands in the higher elevations.

1.2.8 Agricultural Resources

Agriculture, including both the beef industry and irrigated farming, is the most significant economic activity in Far West Texas. The raising of beef cattle occurs in all seven counties, with Brewster County accounting for the greatest number of range cattle. The dairy industry primarily occurs in El Paso County.

With an average annual rainfall of less than 13 inches, the raising of crops in this Region requires irrigation. Most irrigated farming occurs along the flood plains of the Rio Grande in El Paso, Hudspeth, and Presidio Counties, where water is diverted from the River to grow vegetables, cotton, various grain crops, and orchards. Inland, groundwater sources are pumped to the surface to irrigate crops and pastures primarily in Hudspeth (Dell Valley), Culberson (Diablo Farms, Wild Horse Flat, and Lobo Flat), and Jeff Davis (Ryan Flat and Lobo Flat) Counties.

Agricultural activities in the Region that rely on surface water are designed to accommodate the intermittent nature of the supply. In some 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.

The only potential impacts to agricultural are identified with the possible change in water rights use from agricultural use to municipal use of Rio Grande water in El Paso County and groundwater in the Dell City and Diablo Farms areas of Hudspeth and Culberson Counties. As these strategies only potentially change the use of the water and not the volume of diversion, there is no significant impact to natural resources.

1.2.9 Natural Resources

Far West Texas boasts the highest and most scenic desert communities in Texas. The natural resources of the Region include the surface water and groundwater sources described in Section 1.4 and 1.5 of this chapter, and in Chapter 3. Terrestrial and aquatic habitats that provide beautiful vistas, recreational opportunities, and unique wildlife habitats are also natural resources. Understandably, both local residents and tourists make use of these resources in their enjoyment of the numerous public parks within the Region. Big Bend National Park, Guadalupe Mountains National Park, and Big Bend Ranch State Park are three of the largest protected areas in the Region.

Natural resources also include the great diversity of plant and animal wildlife that inhabit these environments. Texas Parks and Wildlife Department's Natural Diversity Database is a comprehensive source of information on species by county that are federally listed, proposed to be federally listed, have federal candidate status, are state listed, or carry a global conservation status indicating a species is critically imperiled, very rare, vulnerable to extirpation, or uncommon. TPWD suggests that due to continuing updates that readers access the most current listing at http://www.tpwd.state.tx.us/landwater/land/maps/gis/ris/endangered_species.

Both plant and animal species endemic to Far West Texas 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 are particularly critical. Springs (Cienegas) emanating from shallow groundwater sources often provide the most constant water supply available for aquatic habitat. "Major Springs" in the Region are listed in Section 1.6 of this chapter and are described in more detail in Appendix 1E of the *2011 Far West Texas Water Plan*, while "ecologically unique river and stream segments" are described in Chapter 8 of this *2016 Plan*.

Of recognized importance to the water planning process is the concern of the effect that future development of water supplies might have on the diversity of species in the Region. Water-supply deficit strategies developed in Chapter 5 of this *Plan* include an evaluation of each strategy's potential impact on the environment and natural resources.

1.3 REGIONAL WATER DEMAND

1.3.1 Major Demand Centers

Total projected year-2020 water consumptive use in Far West Texas is 645,404 acre-feet. The largest category of use is irrigation (471,439 acre-feet), followed by municipalities and county-other (141,818 acre-feet), manufacturing (16,144 acre-feet), steam-electric cooling (6,937 acre-feet), mining (6,069 acre-feet), and livestock (2,997 acre-feet). Seventy-three percent of water used in the Region is by the agricultural sector in support of irrigation. Twenty two percent is used by municipalities and county-other, and the remaining 5 percent supports manufacturing, steam-electric power generation, livestock, and mining. Current and projected water demand for all water-use types are discussed in detail in Chapter 2.

1.3.2 Agriculture

The cultural and physical landscape of Far West Texas has more in common with the desert southwest than with other areas of Texas. The dominant commercial land use throughout the rural areas of the Region is extensive cattle grazing. Aridity and historic land-tenure practices have combined to produce large ranches and low animal densities. The projected total volume of water used in livestock production in the Region in the year 2020 is 2,997 acre-feet. The single largest area of livestock demand is in El Paso County, where 629 acre-feet (21 percent of total livestock demand in the Region) are used by ranches and dairy farms. In the remaining six rural counties, total livestock demand in 2020 ranges from a high of 541 acre-feet in Hudspeth County to a low of 238 acre-feet in Terrell County. The lower numbers associated with the rural counties reflect the lack of concentrated dairy farms outside of El Paso County.

Cow and calf operations dominate the livestock industry in every county except Terrell, where sheep and goats predominate. In addition to livestock, many of the ranches supplement revenue through hunting leases. Dairy operations in El Paso County represent the largest proportion of the market valuation for livestock, as El Paso County traditionally ranks in the top five dairy-production counties in Texas.

There is virtually no rain-fed agriculture (dry-land farming) in Far West Texas, and even irrigated agriculture is confined to a small fraction of the Region. Floodplain-irrigated agriculture is found along the Rio Grande extending above and below El Paso (EPCWID#1) and into southern Hudspeth County (HCCRD#1). A much smaller irrigated strip also occurs along the Rio Grande near Presidio.

Currently, irrigated agriculture based on groundwater pumping is essentially limited to Dell Valley in northeastern Hudspeth County, Diablo Farms in northwestern Culberson County, and Wild Horse and Lobo Flats near Van Horn. High quality cotton, pecans, alfalfa, and vegetables such as tomatoes, onions, and chilies are the major crops of the Region.

Total projected irrigation use in the Region in the year 2020 is 471,439 acre-feet. El Paso and Hudspeth Counties accounted for the greatest amount of irrigation with 242,798 and 178,840 acre-feet of use, respectively. Along the Rio Grande corridor in these two counties, irrigation water is diverted from the River, except during years when flow is significantly below normal. In northeastern Hudspeth County, the Dell Valley farming area irrigates cropland with groundwater pumped from the underlying Bone Spring-Victorio Peak Aquifer.

Irrigation in El Paso and Hudspeth Counties represents 89 percent of total irrigation water use in the Region. Most of the remaining 11 percent of irrigation demand is centered in Culberson County, where 39,928 acre-feet is projected to be used in 2020 to support irrigated agriculture. Greenhouse farming operations near Fort Davis and Marfa have the highest crop (tomatoes) yield per volume of water applied.

The area of land actually irrigated in the El Paso County Water Improvement District #1 in any given year varies from 40,000 to 50,000 acres. The total water rights acreage in the District, however, is 69,010. The City of El Paso currently owns or leases 13,075 acres of land within the District with water rights.

Crop production in Far West Texas is not sustainable without a source of irrigation water. A reduction in the quantity of water available for irrigation will cause a reduction in the number of acres that can be irrigated profitably. Similarly, cutbacks in the supply of water for livestock will cause a reduction in herd size. As water supplies are depleted, modifications will be required to use the available rangeland resource, and water hauling within a given ranch may be required to better distribute water to livestock.

Although drought-like conditions are a relative constant in the Region, extended periods of below-normal rainfall can have significant and long-lasting harmful effects on the rangeland resource. Reduction of livestock numbers because of drought usually lags behind the impact of drought on the range-grass ecosystem. Extended periods of drought can lead to the depletion of grass species and to an increase in shrub species. This leads to a decrease in soil cover and increases the potential for erosion by water and wind.

A decrease in water quality has a greater impact on crop production than on livestock output. As the salinity of irrigation water increases, the amount of irrigation water applied must also increase. This satisfies the leaching requirement, and keeps the root zone salinity at levels that allow for economic crop production. If salinity levels increase, the mixture of crops may change to include crops with greater tolerance to soil salinity.

Groundwater use for irrigated farming principally occurs in Dell Valley, Diablo Farms, and along the various flats that comprise the Salt Basin bolson valley. Principal aquifers from which irrigation water is withdrawn include the Rio Grande Alluvium, Bone Spring-Victorio Peak, Capitan Reef, and the Wild Horse/Michigan, Lobo, and Ryan Flats of the West Texas Bolson Aquifers. Characteristics of these aquifers are described in Chapter 3.

Future availability of water for agricultural use from these aquifers varies. During times of insufficient river flow farmers may use groundwater from the Rio Grande Alluvium to sustain crops. However, because of its high mineral content, this water can only be used on a short-term basis. In Dell Valley, groundwater from the Bone Spring-Victorio Peak Aquifer has deteriorated in quality particularly in the central part of the valley as a result of repeated irrigation water return flow. The aquifer should remain viable in the future as the Hudspeth County Underground Water District #1 limits permitted withdrawals to 101,429 acre-feet or less annually (MAG aquifer limit). Water levels have declined in the past in most parts of the Salt Basin aquifers but have generally recovered due to a decrease in pumpage in recent years.

1.3.3 Municipal and County-Other

The municipal and county-other category of demand consists of both urban residential, rural-domestic, 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. Total projected municipal and county-other water demand in the seven counties in the year 2020 is projected to be 141,818 acre-feet.

The City of El Paso, with a projected water use of 110,573 acre-feet in the year 2020, represents 78 percent of the total municipal and county-other water use in the Region. The City's water demand has decreased over the last several years due to diligent enforcement of conservation measures. Total projected municipal and county-other water use in El Paso County (129,266 acre-feet in 2020), which includes the City of El Paso, other communities, and rural domestic supply, represents 91 percent of the Regional total.

El Paso Water Utilities (EPWU), which serves the City of El Paso, obtains approximately half of its water from the Rio Grande in full river water supply conditions. The remainder is groundwater pumped from well fields in the Mesilla Bolson and Hueco Bolson Aquifers. The Utility also supplies water to other incorporated areas and to businesses within El Paso County.

Other entities in El Paso County not served by EPWU rely exclusively on groundwater resources. All of the cities and unincorporated areas of the six rural counties likewise depend entirely on groundwater resources from aquifers located in their respective areas.

Following necessary treatment, water supplies developed for municipal consumption are expected to meet "primary" and "secondary" safe drinking-water standards mandated by the U.S. Environmental Protection Agency and the Texas Commission on Environmental Quality. "Primary standards" address dissolved particulates (e.g., heavy metals and organic contaminants) that are known to have adverse effects on human health. "Secondary standards" address factors that affect the aesthetic quality (e.g., taste and odor) of drinking water.

Water quality varies widely within the Region. In much of the rural counties, groundwater is of sufficient quality that only chlorination is required as a means of treatment. In other areas, various methods of treatment are required to bring the water into compliance with primary and secondary standards. For example, Dell City, El Paso, and Horizon Regional MUD operate desalination plants or well head facilities to reduce the concentration of total dissolved solids (TDS) in groundwater extracted from local aquifers.

The City of El Paso (EPWU) actively treats available water supplies to meet drinking-water standards. These operations include the blending of fresh water with marginally elevated TDS water to increase available supplies, and the tertiary treatment of wastewater to generate supplies for reuse. El Paso has updated its treatment facilities to accommodate the recently lowered arsenic concentration standard. The City of El Paso and Fort Bliss have jointly constructed the Kay Bailey Hutchison Desalination Facility, a 27.5 MGD desalination plant that makes use of brackish groundwater in the Hueco Bolson Aquifer, thus preserving fresh water in the aquifer for drought protection and emergency use.

County-other is an aggregation of residential, commercial, and institutional water users in cities with less than 500 people or non-city utilities that provide less than an average of 250,000 gallons per day, as well as unincorporated rural areas in a given county. The county-other total water demand for the Region is 8,057 acre-feet/year (Figure 1-10).

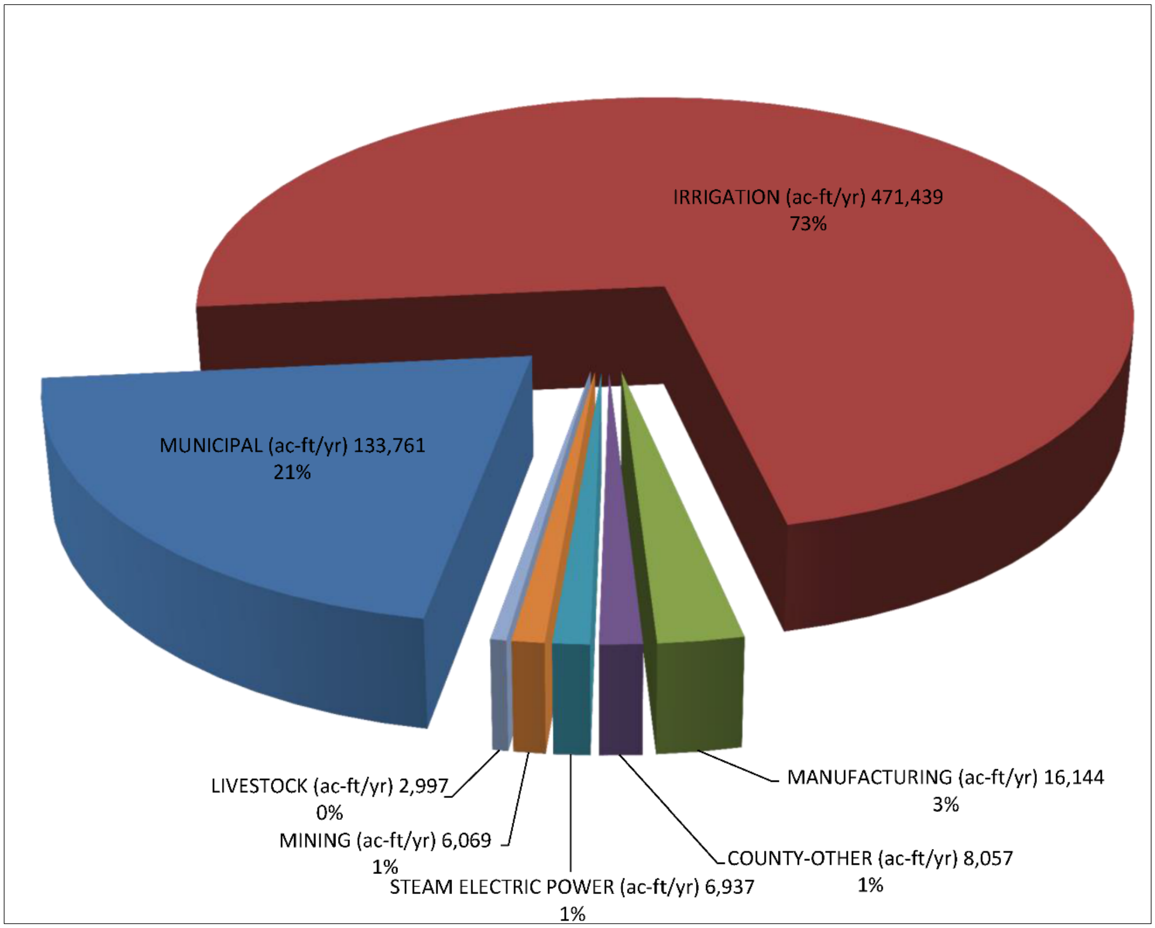


Figure 1-10. Year 2020 Projected Water Demand by Water-Use Category

1.3.4 Wholesale Water Providers

A wholesale water provider is defined as any entity that had contracts to sell more than 1,000 acre-feet of water wholesale in any one year during the five years immediately preceding the adoption of the last regional water plan (2011), or that is expected to enter into contracts to sell more than 1,000 acre-feet of water per year wholesale during the period covered by this *Plan* (2011–2016). Entities meeting this definition and entities to which they contract are as follows:

El Paso County Water Improvement District #1

- El Paso Water Utilities

El Paso Water Utilities

- Lower Valley Water District
- Fort Bliss
- Vinton
- County Other
- El Paso Electric
- Manufacturing
- Mining

Lower Valley Water District

- Socorro
- San Elizario
- Clint
- Other Retail Customers

Horizon Regional MUD

- Horizon City

The El Paso County Water Improvement District #1 primarily delivers water from the Rio Grande to irrigators in El Paso County. However, it also sells water from the Rio Grande to the City of El Paso through EPWU. In 2014, the District provided 24,089 acre-feet to EPWU. Surface water deliveries to EPWU since 2011 have been less than half of the anticipated full deliveries (60,000 acre-feet) available during normal Rio Grande flow years.

EPWU obtains raw surface water from the El Paso County Water Improvement District #1 as explained above, and groundwater from its own wells in the Hueco and Mesilla Bolson Aquifers. While most of this water is used within the City of El Paso, as much as 10,592 acre-feet were sold in 2013 to Fort Bliss, Lower Valley Water District and other entities. The Lower Valley Water District is a significant supplier of water to Socorro, San Elizario, Clint, and other retail customers and receives all of its supply from EPWU. Horizon Regional MUD supplies water to Horizon City and other local retail customers.

1.3.5 Industrial, Manufacturing, Electric Power Generation, and Mining

Industrial and manufacturing companies, which represent a significant component of the economy of Far West Texas, are mostly located in El Paso County where all but 6 acre-feet of the total 16,144 acre-feet of water projected to be used in the Region in the year 2020 is used in El Paso County. The industrial, manufacturing and power generation sectors purchase water from EPWU, or are self-supplied by water wells. In some cases, companies use treated wastewater provided by EPWU through the Utility's purple-pipe program.

El Paso Electric Company located in El Paso County is the only facility within the Region that uses water in the form of steam to generate electricity (6,937 acre-feet in 2020). Anticipated local population growth, as well as increasing commercial and manufacturing power needs, means that the quantity of water needed to produce electricity will likewise increase. El Paso Electric currently purchases most of its water supply from EPWU.

Chemical quality standards for water used for industrial purposes vary greatly with the type of industry utilizing the water. The primary concern with many industries is that the water does not contain constituents that are corrosive or scale forming. Also of concern are those minerals that affect color, odor, and taste; therefore, water with a high concentration of dissolved solids is avoided in many manufacturing processes.

The mining sector accounts for the smallest area of demand, with 6,069 acre-feet of projected total use in the Region in 2020.

1.3.6 Environmental and Recreational Water Needs

Environmental and recreational water use in Far West Texas 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 and mining.

Natural and environmental resources are often overlooked when considering the consequences of prolonged drought conditions. All living organisms require water. The amount and quality of water required to maintain a viable population, whether it be plant or animal, is highly variable. 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.

Recreation activities involve human interaction with the outdoor environment. Many of these activities are directly dependent on water resources such as fishing, swimming, and boating; while a healthy environment enhances many others, such as 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 Far West Texas as well as the tens of thousands of annual visitors to this Region. Environmental and recreational water needs are further discussed throughout the *Plan*.

1.4 SURFACE WATER SUPPLY SOURCES

1.4.1 Rio Grande

The Rio Grande originates in southwestern Colorado and northern New Mexico, where it derives its headwaters from snowmelt in the Rocky Mountains. The Elephant Butte Dam and Reservoir in New Mexico is approximately 125 miles north of El Paso and can store over two million acre-feet of water. Water in the reservoir is stored to meet irrigation demands in the Rincon, Mesilla, El Paso, and Juarez Valleys and is released in a pattern for power generation. Above El Paso, flow in the River is largely controlled by releases from Caballo Reservoir located below Elephant Butte; while downstream from El Paso to Fort Quitman, flow consists of treated municipal wastewater from El Paso, untreated municipal wastewater from Juarez, and irrigation return flow. Below the El Paso-Hudspeth County line, flow consists mostly of return flow and occasional floodwater and runoff from adjacent areas. Channel losses are significant enough that the Rio Grande is often dry from below Fort Quitman to the confluence with the Mexican river, the Rio Conchos, upstream of Presidio. The Rio Conchos is the only significant perennial tributary in the 350 miles between Elephant Butte Reservoir and Presidio.

The Rio Grande is unique in its complexity of distribution management. Because the waters of the River must be shared between three U.S. states and the nation of Mexico, a system of federal, state and local programs has been developed to oversee the equitable distribution of water. The compacts, treaties and projects that currently provide the River's management framework are discussed in Chapter 3.

1.4.2 Pecos River

The Pecos River forms the eastern boundary of Far West Texas only for a short distance at the northeast corner of Terrell County (Figure 1-11). As a major tributary to the Rio Grande, the headwaters of the Pecos River originate as snowmelt east of Santa Fe, New Mexico in the Sangre de Cristo Mountains. The River flows southward through eastern New Mexico, where Red Bluff Lake impounds it at the Texas-New Mexico border. The Pecos River Compact provides the apportionment and division of Pecos River waters between New Mexico and Texas and is administered by the Pecos River Compact Commission. Although Pecos River water is typically too salty for human consumption, it has been a source for irrigation in Pecos, Reeves and Ward Counties. Downstream in Terrell County, water in the Pecos is mostly relegated to livestock use.

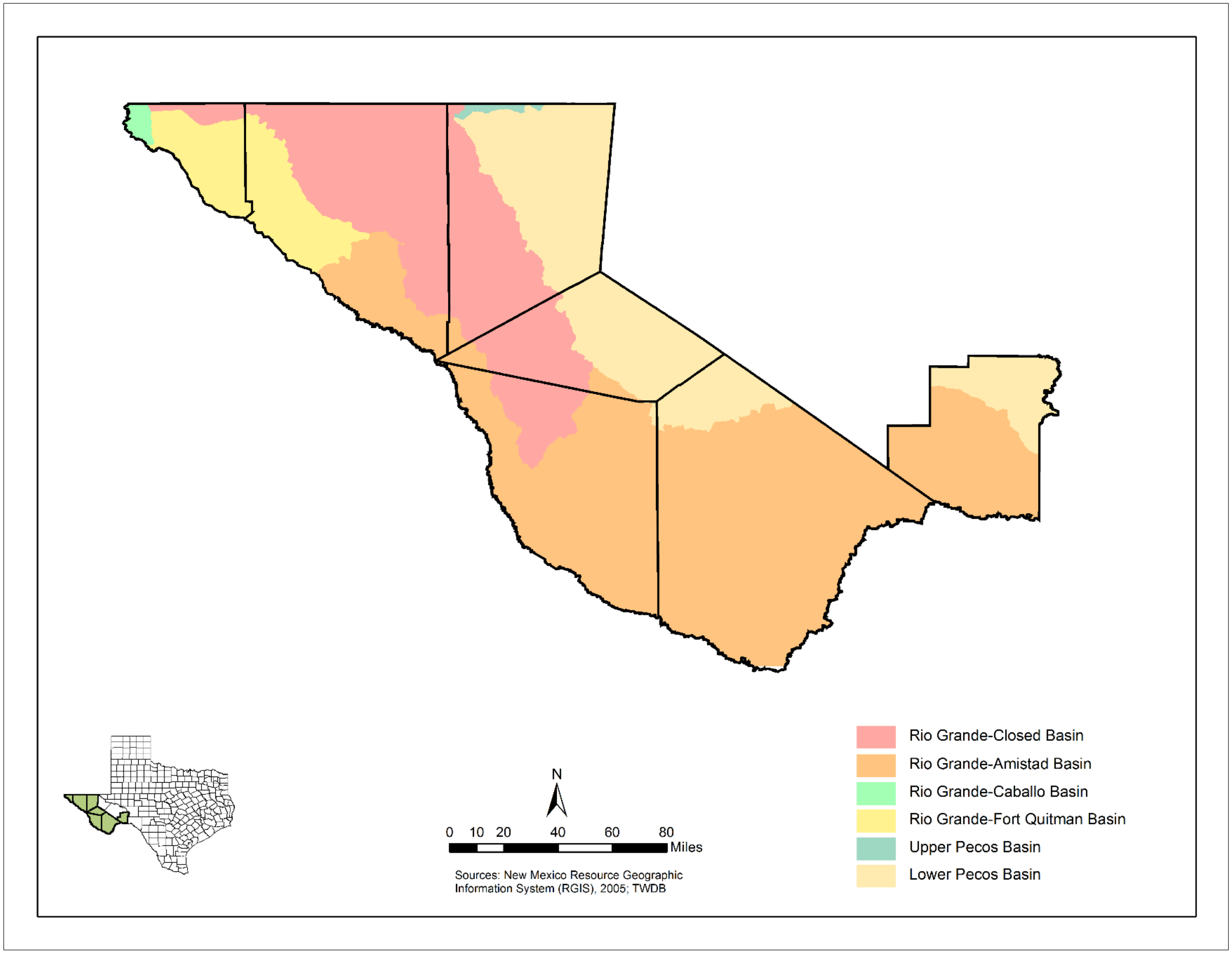


Figure 1-11. Rio Grande and Pecos River Basins and Sub-Basins on the U.S. Side of the International Border

1.4.3 Ecologically Unique River and Stream Segments

As a part of the planning process, regional planning groups may include recommendations of ecologically unique river and stream segments in their adopted regional water plans (31 TAC 357.8). The Texas Legislature may designate a river or stream segment of unique ecological value following the recommendations of a regional water planning group. As per §16.051(f) of the Texas Water Code, this designation solely means 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 segment designated by the legislature under this subsection.

The FWTWPG chooses to respect the privacy of private lands and therefore recommends as "Ecologically Unique River and Stream Segments" (Figure 1-12) three streams that lie within the boundaries of state-managed properties, four within National Park boundaries, and specified streams managed by the Texas Nature Conservancy and the Trans Pecos Water Trust. These stream and river segments are described in Chapter 8.

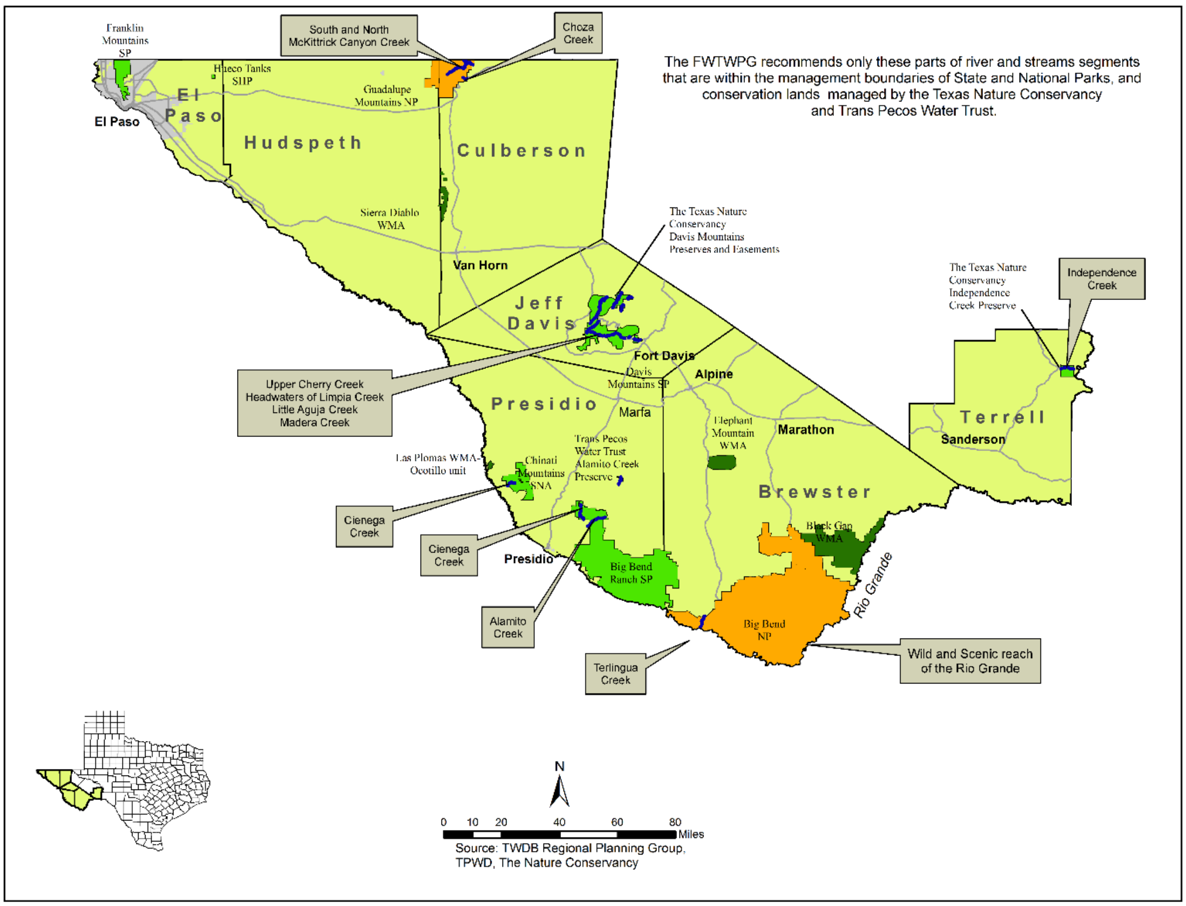


Figure 1-12. Recommended Ecologically Unique River and Stream Segments

1.5 GROUNDWATER SUPPLY SOURCES

Outside of the Rio Grande corridor, almost all water supply needs are met with groundwater withdrawn from numerous aquifers in the Region (Figure 1-13). Depth to water, well yields, and chemical quality dictate how these resources are used. A more thorough discussion of the aquifers, especially as it relates to water supply availability, can be found in Chapter 3. Aquifers recognized in the Region include the following:

- Hueco Bolson
- Mesilla Bolson
- Edwards-Trinity (Plateau)
- Bone Spring-Victorio Peak
- Capitan Reef
- Igneous
- Marathon
- Rustler
- West Texas Bolsons

Other locally recognized groundwater sources:

- Rio Grande Alluvium
- Balmorhea Alluvium
- Diablo Plateau
- Edwards-Trinity of Southern Brewster County

1.5.1 Hueco and Mesilla Bolson Aquifers

The Hueco Bolson Aquifer extends from east of the Franklin Mountains in El Paso County southeastward into southern Hudspeth County, and continues a short distance north into New Mexico and south into Mexico. The Hueco Bolson along with the Mesilla Bolson Aquifer provides approximately half of the municipal supply for the City of El Paso and is the principal source of municipal supply for Ciudad Juarez, Mexico.

The Mesilla Bolson Aquifer lies in the Upper Rio Grande Valley west of the Franklin Mountains and extends to the north into New Mexico where it is primarily used for agricultural and public supply purposes. In Texas, the agricultural use of this aquifer is much less than in New Mexico. El Paso Water Utilities' Canutillo Well Field is located in the Mesilla Bolson.

1.5.2 Edwards-Trinity (Plateau) Aquifer

The Edwards-Trinity (Plateau) Aquifer underlies the Edwards Plateau east of the Pecos River and the Stockton Plateau west of the Pecos River, and provides water to all or parts of 38 Texas counties. The aquifer extends from the Hill Country of Central Texas to the Trans-Pecos region of Far West Texas, where it is a source of water in Brewster, Culberson, Jeff Davis and Terrell Counties. There is relatively little pumpage from the aquifer over most of its extent in Far West Texas, with the City of Sanderson in Terrell County being the only municipality in the Region that pumps water from the State-designated potion of this aquifer.

1.5.3 Bone Spring-Victorio Peak Aquifer

The Bone Spring-Victorio Peak Aquifer is located in northeast Hudspeth County along the eastern edge of the Diablo Plateau, west of the Guadalupe Mountains, and extends northward into the Crow Flats area of New Mexico. The aquifer is used primarily as a source of irrigation water. Dell City is the only municipality that relies on the aquifer as a source of public supply; however, the City must filter the water through a desalination process to render the water supply potable. The Hudspeth County Underground Water Conservation District #1 regulates the quantity of water withdrawn from the aquifer. The boundary of the district was recently extended to include the TWDB revised extent of the aquifer.

1.5.4 Capitan Reef Aquifer

The Capitan Reef Aquifer is contained within a relatively narrow strip of limestone formations (10 to 14 miles wide) that formed along the shelf edge of the ancestral Permian Sea. In Texas, the reef formations are exposed in the Guadalupe, Apache, and Glass Mountains and trend northward into New Mexico, where the aquifer is a source of abundant fresh water for the City of Carlsbad. Within Far West Texas, the aquifer underlies sections of Culberson County and a small area of northern Brewster County. EPWU owns approximately 29,000 acres overlying the Capitan Reef aquifer in northwestern Culberson County and may tap this aquifer for future needs (*see EPWU strategies in Chapter 5*).

1.5.5 Igneous Aquifer

The Igneous Aquifer occurs in the Davis Mountains of Jeff Davis County and extends outward into Brewster and Presidio Counties. The Cities of Alpine, Fort Davis and Marfa rely on the aquifer as a source of municipal supply.

1.5.6 Marathon Aquifer

The Marathon Aquifer is located entirely within north-central Brewster County and is used primarily as a municipal water supply by the Community of Marathon and for rural domestic and livestock purposes.

1.5.7 Rustler Aquifer

The Rustler Formation is exposed in eastern Culberson County and plunges eastward into the subsurface of adjacent counties. The aquifer is principally located beneath Loving, Pecos, Reeves and Ward Counties, where it yields water for irrigation, livestock and water-flooding operations in oil-producing areas. No communities in Far West Texas rely on this aquifer as large concentrations of dissolved solids render the water unsuitable for human consumption.

1.5.8 West Texas Bolsons Aquifer

Several deep bolsons, or basins, filled with sediments eroded from the surrounding highlands underlie Far West Texas. In places, the bolsons contain significant quantities of groundwater. These bolsons are referred to as Red Light Draw, Eagle Flat, Green River Valley, Presidio-Redford, and the Salt Basin. The Salt Basin is subdivided from north to south into the Upper Salt Basin and Wild Horse, Michigan, Lobo, Ryan Flats. The bolson aquifers provide variable amounts of water for irrigation and municipal water supplies in parts of Culberson, Hudspeth, Jeff Davis and Presidio Counties. The communities of Presidio, Sierra Blanca, Valentine and Van Horn rely on the bolson aquifers for municipal water supplies.

1.5.9 Other Groundwater Resources

Also shown in Figure 1-13 are large areas of Far West Texas that are not underlain by designated major or minor aquifers. The map, however, should not be interpreted as an indication that such areas are devoid of groundwater, but rather as a reflection of the current level of understanding of the extent of known groundwater resources in the Region.

Rio Grande Alluvium Aquifer

The Rio Grande Alluvium Aquifer consists of Quaternary floodplain sediments laid down by the Rio Grande as the river cut into the surface of the Hueco Bolson. The floodplain forms a narrow valley within the topographically lowest part of the Hueco Bolson and extends nearly 90 miles from El Paso to Fort Quitman, where the valley is constricted between the Sierra de la Cienguilla of Chihuahua and the Quitman Mountains of Hudspeth County. The aquifer is hydrologically connected with the underlying Hueco Bolson, and is occasionally a source of irrigation water for farms in El Paso and Hudspeth Counties.

Balmorhea Alluvium Aquifer

The Balmorhea Alluvium Aquifer is located in a small area along the Jeff Davis and Reeves county line and is composed of a relatively shallow layer of gravel that overlies Cretaceous limestone. The Balmorhea Alluvium Aquifer is recognized in this *Plan* due to its use as a municipal supply source for the City of Balmorhea and the Madera Valley WSC, both located in Reeves County in the adjacent Region F.

Diablo Plateau Aquifer

Thick limestone beds that make up the subsurface of the Diablo Plateau of central and northern Hudspeth County (west of Dell City) may have significant volumes of groundwater in storage. Although relatively few exploration wells have been drilled on the Plateau, the aquifer likely contains sufficient water to be considered as a potential source of groundwater.

Edwards-Trinity (Plateau) Aquifer of Brewster and Presidio Counties

In southern Brewster County, the communities of Lajitas, Study Butte, and Terlingua, as well as much of Big Bend National Park, withdraw their municipal supplies from Cretaceous limestone aquifers that are equivalent to the Edwards-Trinity (Plateau) Aquifer. Further evaluation is needed to arrive at a better understanding of the water-resource development potential in these areas.

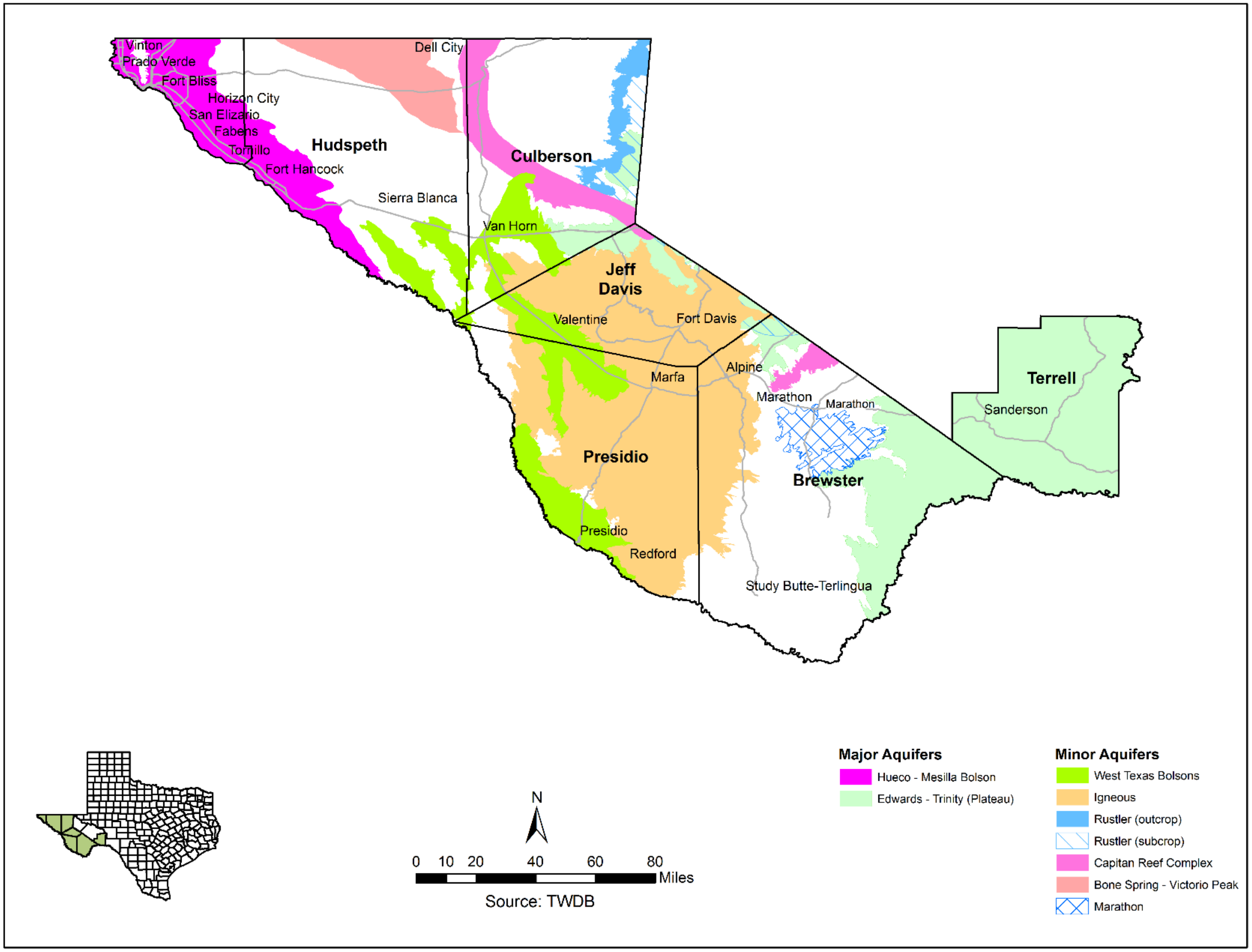


Figure 1-13. Major and Minor Aquifers of Far West Texas

1.6 MAJOR SPRINGS

Springs and seeps are found in all seven of the Far West Texas counties and have played an important role in the development of the Region. Springs were important sources of water for Native Americans, as indicated by the artifacts and petroglyphs found in the vicinity of many of the springs. In the 18th and 19th centuries, locations of transportation routes including supply and stage coach lines, railroads, military outposts, and early settlements and ranches were largely determined by the occurrence of springs that issued from locations in the mountains and along mountain fronts. Figure 1-14 shows the regional distribution of documented springs in the Region that are currently in existence or are of historical significance.

Springs contribute to the esthetic and recreational value of private land and parkland in Far West Texas - especially in the Big Bend area, where a number of thermal springs discharge along the banks of the Rio Grande. Springs are significant sources of water for both aquatic and terrestrial wildlife as they form small wetlands that attract migratory birds and other fowl that inhabit the Region throughout the year. As documented by the Texas Parks and Wildlife Department, springs also provide habitat for threatened and endangered species of fish (such as the Pecos and the Big Bend Gambusia).

The FWTWPG recognizes the importance of all springs in this desert community for their contribution as a water supply source and as natural habitat. However, the FWTWPG chooses to respect the privacy of private lands and therefore specifically identifies the following "Major Springs" occurring only on state, federal, or privately owned conservation managed lands (Figure 1-15). Many of these springs also are the primary source of flow to the "ecologically unique river and stream segments" described in Chapter 8. Descriptions of these springs are provided in Appendix 1E of the *2011 Plan* which can be accessed at the following link:
http://www.twdb.texas.gov/waterplanning/rwp/plans/2011/E/Complete_Region_E_Final_Final_2011Report.pdf.

La Baviza Spring, Chinati Mountains State Natural Area – Presidio County

Big Bend National Park / Rio Grande Wild and Scenic River Springs – Brewster County

- Gambusia Hot Springs Complex
- Outlaw Flats Spring Complex
- Las Palmas Spring Complex
- Madison Fold Spring Complex

Guadalupe Mountains National Park – Culberson County

- Bone Spring
- Dog Canyon Spring
- Frijole Spring
- Goat Seep
- Guadalupe Spring

- Juniper Spring
- Manzanita Spring
- Smith Spring
- Upper Pine Spring

Texas Nature Conservancy – Independence Creek Preserve – Terrell County

- Caroline Spring

Texas Nature Conservancy – Davis Mountains Preserve – Jeff Davis County

- Tobe Spring
- Bridge Spring
- Pine Spring
- Limpia Spring

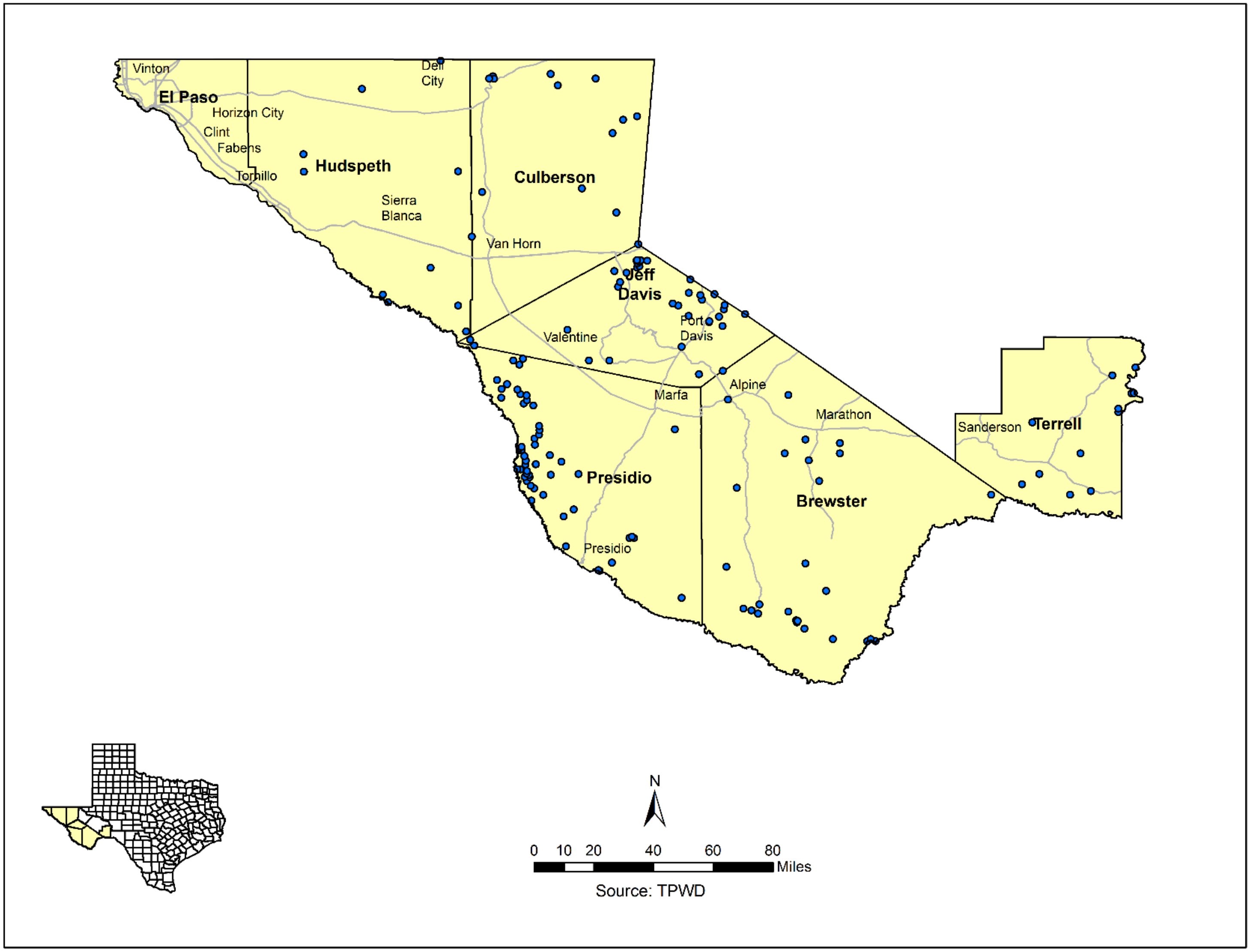


Figure 1-14. Location of Documented Springs

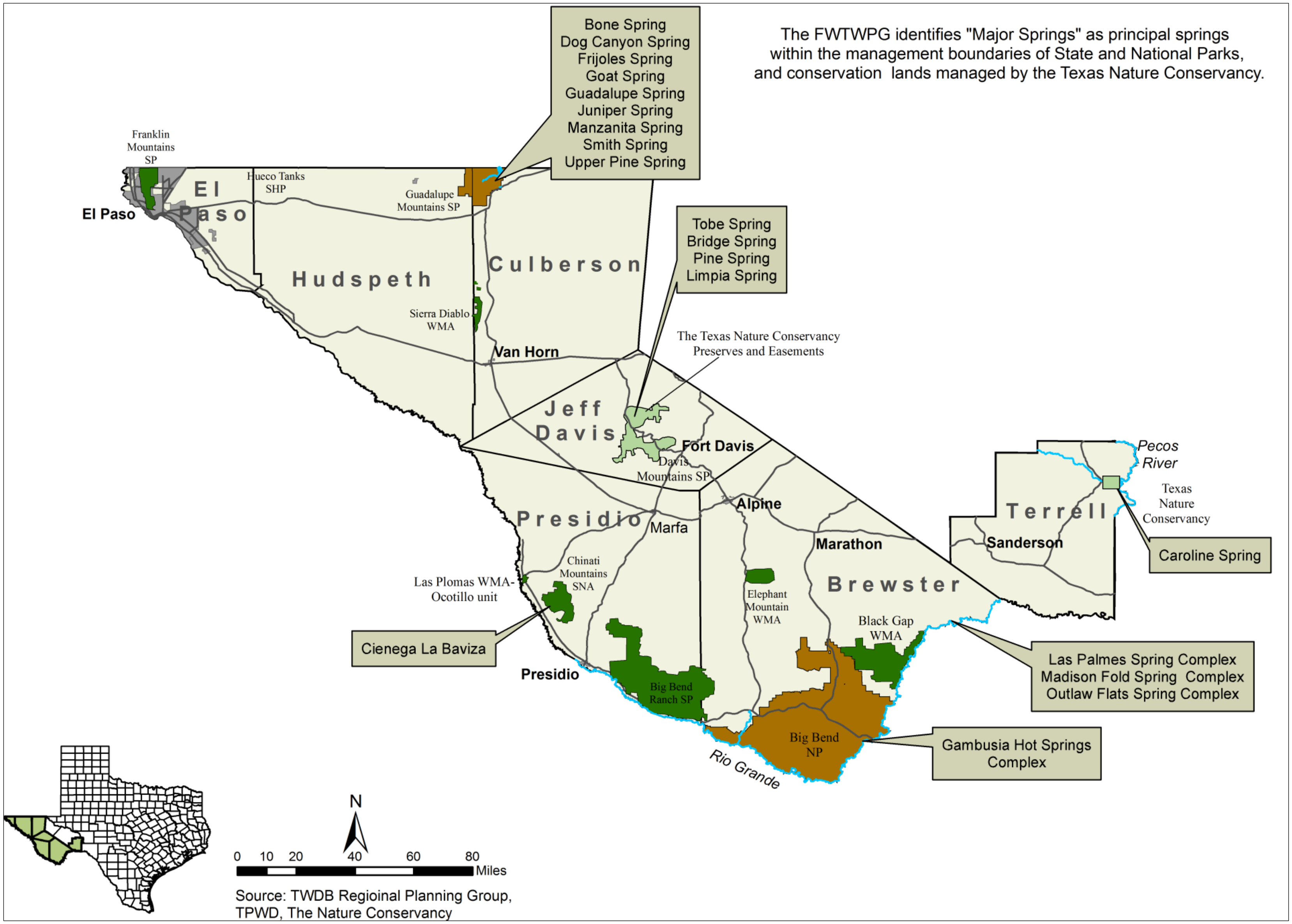


Figure 1-15. Location of Identified Major Springs

1.7 REUSE

El Paso has nearly 50 miles of reclaimed-water pipelines (purple pipeline) in place in all areas of the City. Reclaimed water serves the landscape irrigation demand of golf courses, parks, schools, and cemeteries, and also provides water supplies for steam electric plants and industries within the City. EPWU does not plan on extending or growing the purple pipe infrastructure, but will focus on maintaining existing purple pipe customers and work towards increasing the use of reclaimed water through additional purified water projects.

1.8 IDENTIFIED WATER QUALITY PROBLEMS

Water quality plays an important role in determining the availability of water supplies to meet current and future water needs in the Region. The quality of groundwater and surface water is evaluated to help determine the suitability of each source for use and the potential impacts on these sources that might result from the implementation of recommended water management strategies.

1.8.1 Water Quality Issues

Groundwater quality issues in the Region 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. Some aquifers, however, have a low TDS but may contain individual constituent levels that exceed safe drinking-water standards. For example, some wells in the Davis Mountains Igneous Aquifer have exceptionally low TDS but contain unsatisfactory levels of fluoride. Also fresh-water wells in the Study Butte-Terlingua- Lajitas area have elevated levels of radioactivity.

Groundwater quality changes are often the result of man's activities. In agricultural areas, aquifers such as the Bone Spring-Victorio Peak have increased in TDS. Irrigation water applied on the fields percolates back to the aquifer carrying salts leached from the soil. Beneath El Paso and Ciudad Juarez, the average concentration of dissolved solids in the Hueco Bolson Aquifer has increased as the fresher water in the aquifer is being consumed. Although local instances of groundwater quality degradation have occurred in the Region, there are no major trends that suggest a widespread water-quality problem due to the downward percolation of surface contaminants.

The Rio Grande and the Pecos River are the principal surface water sources in Far West Texas. Unlike groundwater, surface water quality can vary significantly depending on the amount of flow in the streambed and the rate and source of runoff from adjacent lands. Salinity is an issue associated with the Rio Grande, especially during drought conditions. River flows arriving at El Paso contain a substantial salinity contribution from irrigation return flow and municipal wastewater return in New Mexico. Under current conditions, approximately 25 percent of the applied irrigation water is needed to move through the project in El Paso County to keep the salt loading at reasonable and manageable levels given average surface flow rates. Studies have shown that salinities in the Rio Grande can increase to over 1,000 mg/l during May and September, depending on actual irrigation demands and releases from reservoirs. Prolonged low flow increase salt storage in riverbanks and riparian zones, which can then be flushed out during high flows.

Downstream from El Paso, most of the flow consists of irrigation return flow, and small amounts of treated and untreated municipal wastewater. Heavy metals and pesticides have been identified along this segment of the Rio Grande. Flow is intermittent downstream to Presidio, where the Rio Conchos augments flow. Fresh water springs contribute to the Rio Grande flow in the Big Bend and enhance the overall quality of the River through this reach.

The Pecos River is not a source of drinking water for communities in Far West Texas; however, it is the most prominent tributary to the Rio Grande on the Texas side of the River above Amistad Reservoir. According to IBWC data, the Pecos River contributes an average of 11 percent of the annual stream flow in the Rio Grande above the Reservoir and 29 percent of the annual salt load. Independence Creek's contribution in Terrell County increases the Pecos River water volume by 42 percent at the confluence and significantly reduces the total suspended solids, thus improving both water quantity and quality.

1.8.2 Supply Source Protection

According to the 1996 Safe Drinking Water Act Amendments, the Texas Commission on Environmental Quality (TCEQ) is required to assess every public drinking water source for susceptibility to certain chemical constituents. The Source Water Protection Program 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 1-1 lists Far West Texas public water systems currently involved in the TCEQ's Source Water Protection Program. A list of participants State-wide can be accessed at the following link: https://www.tceq.texas.gov/drinkingwater/SWAP/participants.html.

Table 1-1. Far West Texas Source Water Protection Participants

Utility Name	County	Report Date
Castolon Paint Area BNP	Brewster	5/30/2000
Panther Junction PLT	Brewster	7/30/2000
Rio Grande Village BBNP	Brewster	5/31/2000
Big Bend National Park Chisos Basin Water	Brewster	5/31/2000
City of Van Horn	Culberson	7/31/1994
El Paso Water Utilities Public Service Board	El Paso	5/31/1990
El Paso County WCID 4 Fabens	El Paso	7/31/1999
El Paso County Tornillo WID	El Paso	7/31/1999
Fort Bliss Main Post Area	El Paso	7/31/1990
Dell City	Hudspeth	7/31/1994
For Davis WSC	Jeff Davis	7/31/1994
City of Marfa	Presidio	1/31/1995

1.8.3 Water-Supply Source Vulnerability

Following the events of September 11th, Congress passed the Bio-Terrorism Preparedness and Response Act. Drinking water utilities serving more than 3,300 people were required and have completed vulnerability preparedness assessments and response plans for their water, wastewater, and stormwater facilities. The U.S. 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:

- In*terim Voluntary Security Guidance for Water Utilities* www.awwa.org
- *Interim Voluntary Security Guidance for Wastewater/Stormwater Utilities* www.wef.org
- *Interim Voluntary Guidelines for Designing an Online Contaminant Monitoring System* www.asce.org

1.9 WATER LOSS AUDITS

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 retail public utilities providing water within Texas file a standardized water audit once every five years with the Texas Water Development Board (TWDB). 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. By reducing water loss, utilities can increase their efficiency, improve their financial status, minimize their need for additional water resources, and assist long-term water sustainability.

Any retail water supplier that has an active financial obligation with the TWDB is required to submit a water loss audit annually. Additionally, retail water suppliers with more than 3,300 connections are now required to submit an audit annually. In addition, all retail public water suppliers are required to submit a water loss audit once every five years. The next scheduled audit for this requirement is for the year 2015 and will be due by May 1, 2016. The audits should help answer these questions:

1. Where did we lose the water?
2. How much water was lost?
3. How much did the loss cost the utility?
4. Why did we lose the water?

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), which can be viewed at http://www.twdb.texas.gov/publications/brochures/conservation/doc/WaterLossManual_2008.pdf. Table 1-2 provides a listing of reported utility audits performed in Far West Texas. The link provided below accesses a more detailed water loss audit report maintained by the TWDB (http://www.twdb.texas.gov/conservation/municipal/waterloss/index.asp).

Table 1-2. Far West Texas 2010 Public Water System Real Water Loss Report (gallons)

Public Water Supply Name	System Input Volume	Reported Breaks Leaks	Unreported Loss	Total Real Losses	Cost Of Real Losses	Percent Total Loss
City of Alpine	Unreported	0	0	0	0	0
City of Marfa	173,166,667	1,000,000	7,697,121	8,697,121	17,394	8.34
City of Presidio*	234,431,148	2,500,000	20,026,722	22,526,722	13,741	13.39
City of Valentine	0	0	0	0	0	0
City of Van Horn*	283,191,992	2,000,000	43,766,627	45,766,627	137,300	20.88
Cuadrilla Improvement Corp	1,315,670	0	-2,350,368	-2,350,368	-1,175	0
Dell City*	17,700,612	8,000	2,689,469	2,697,469	2,697	17.09
El Paso County Tornillo WID	110,869,059	110,000	690,058	800,058	4,960	3.93
El Paso County WCID 4 Fabens	269,801,856	168,125	758,352	926,477	463	3.52
El Paso Water Utilities Public Service Board	38,110,575,510	19,992,000	596,584,452	616,576,452	1,233,153	7.68
Esperanza Water Service	47,825,510	177,965	3,805,673	3,983,638	19,918	10.38
Fort Davis Estates	0	0	0	0	0	0
Fort Davis WSC	71,748,856	50,000	5,320,127	5,370,127	1,611	9.47
Fort Hancock WCID*	18,913,776	168,100	3,673,346	3,841,446	15,366	22.11
Marathon Water Supply & Sewer Service Co*	325,947,368	2,500,000	63,346,393	65,846,393	16,462	32.21
Panther Junction Plt*	18,211,718	150,000	3,401,657	3,551,657	355,166	19.75
Rio Grande Village BBNP*	5,011,730	500,000	2,730,772	3,230,772	6,462	63.55
Town of Anthony*	189,915,179	325,851	13,206,840	13,532,691	6,766	15.88
Valley Acres MHP Water System	823,449	1	4,996	4,997	12	0.86
Villa Alegre Estates	3,503,469	0	154,863	154,863	232	5.61
Vinton Hills Subdivision	23,655,258	0	1,528,540	1,528,540	2,293	7.63
Vinton Village Estates	12,297,959	16,315	447,330	463,645	695	5.03

* American Water Works Association (AWWA) recommends entities with more than 10% water loss take corrective action.

1.10 COLONIAS

1.10.1 State Perspective

Colonias represent a special and growing subset of municipal water demand in the Region, and present a challenge to water suppliers. While some colonias in the Region are centuries-old historic settlements, most are substandard subdivisions in unincorporated areas located along the United States/Mexico international border that have been illegally subdivided into small parcels characterized by a lack of basic services. These small parcels do not have a drinking water supply, wastewater services, paved roads, or proper drainage, and are typically sold to individuals of modest means who may be unaware of the negative consequences of purchasing illegally subdivided property. 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 supply and wastewater services to the colonias. 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 June 1, 2005. Affected areas 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 this program are available on the TWDB web site http://www.twdb.texas.gov/financial/programs/EDAP/index.asp.

EDAP projects in Far West Texas are located in Brewster, El Paso, Hudspeth, and Terrell Counties and are described in Table 1-3. Data pertaining to all EDAP projects in the State can be accessed through the TWDB web site http://www.twdb.texas.gov/publications/reports/edap_reports/doc/Status.pdf.

Table 1-3. Economically Distressed Area Program Projects in Far West Texas (August 31, 2014)

County	Sponsor	Project	Activity	Citizens Served	Cost (Millions)	Status
Brewster	City of Alpine	Southeast Interceptor	Wastewater	6,053	$0.29	Completed Planning Design 10/30/11
El Paso	City of El Paso	Canutillo	Water & Wastewater	2,846	$11.06	Completed 4/30/02
El Paso	City of El Paso	Westway II	Water & Wastewater	8,187	$5.65	Completed 5/23/00
El Paso	City of El Paso	East Montana	Water	N/A	$0.44	Completed Facility Plan
El Paso	City of El Paso	Canutillo Water	Water	N/A	$0.41	Active PAD
El Paso	City of El Paso	Canutillo Water	Water	N/A	$0.09	Active Planning
El Paso	City of El Paso	Montana Vista	Wastewater	N/A	$0.04	Active Planning
El Paso	El Paso County	East Montana	Water	7,929	$13.58	Completed 7/29/03
El Paso	Lower Valley Water District	Socorro Bauman	Water	3,927	$1.80	Completed 8/17/94
El Paso	Lower Valley Water District	Socorro Phase II	Water & Wastewater	9,299	$21.68	Completed 4/11/03
El Paso	Lower Valley Water District	Socorro Phase III/San Elizario	Water & Wastewater	26,403	$56.15	Completed 5/19/03
El Paso	Lower Valley Water District	Las Azaleas	Wastewater	N/A	$0.05	Completed Facility Plan
El Paso	El Paso WCID	Westway II	Water	9,052	$1.44	Completed 4/22/96
El Paso	Homestead MUD	Eastside Montana	Water	16,750	$9.24	Completed 7/01/98
El Paso	El Paso County Tornillo WID	Tornillo	Wastewater	2,368	$13.69	Completed 11/30/10
El Paso	City of El Paso	Turf Estates	Water	428	$0.57	Completed 8/30/13
Hudspeth	Hudspeth County WCID #1	Sierra Blanca	Wastewater	1,100	$2.23	Completed 7/28/00
Hudspeth	Ft. Hancock WCID	Ft. Hancock WCID	Water	1,230	$3.0	Completed 1/30/12
Terrell	Terrell County WCID #1	Sanderson	Wastewater	1,128	$4.20	Completed 6/16/03

1.10.2 El Paso County Colonias

In December 1998, the TWDB estimated that there were 172 colonias within the Far West Texas area. In El Paso County alone, 156 colonias were recognized. In August 2003, El Paso Water Utilities (EPWU) and the Border Environment Cooperation Commission (BECC) prepared a Regional Water and Wastewater Service Plan that described existing water and wastewater needs within El Paso County. The report indicated that 3.36 percent of the population was unserved by a community water system and 34.44 percent was unserved with a community sewer system. An estimated 35 different colonias did not have a public water system at the time. The report provided population, demand and growth projections for the entire county by specific area.

During the last 23 years, EPWU has served as a program manager to assist outlying water districts in applying for funding, master planning, design, and construction management. As regional water planner for El Paso County, EPWU continues to work with various water districts and colonia residents in an effort to consolidate efforts in securing adequate water supplies and to capitalize on economies of scale. Efforts to provide water service to outlying areas have resulted in approximately 97 percent of the population within El Paso County having access to clean potable water.

Table 1-4 provides a summary of El Paso County colonia projects and the current status of each area. The projects shown are in different stages of consideration. Funding has, and continues to be, the greatest challenge in moving forward with these projects. Given the limited number of residents (connections) and the large construction costs associated with each project, there are many areas where it is simply not feasible to construct needed facilities until such time as either an increased number of connections are made and/or most importantly, increased amounts of state and federal grant funding are available. In certain areas, it may be feasible to consider small onsite treatment systems, such as wellhead reverse osmosis systems. Such systems could be less expensive and allow for residents to obtain water until a more direct municipal supply is available. EPWU has continued to take the lead in identifying funding and in managing the projects within and/or on behalf of El Paso County. Title 30, Texas Administrative Code, Chapter 285 and the Texas Health and Safety Code, Chapter 366, §366.032 requires residents in rural areas of the county who do not have piped sewer infrastructure to comply with septic tank installation standards and receive a certificate of compliance prior to receiving water, gas, and electric utility service. Known as the On Site Septic Facility (OSSF) program, this program is intended to prevent unhealthy conditions and protect underground water, and is enforced by the El Paso City/County Health and Environmental District.

Table 1-4. El Paso County Colonia Projects (August 19, 2010)

Sponsor/ Applicant	Project Location	Activity	Population Served	Cost Estimate	Identified Source of Funds	Status
El Paso County/ EPWU	Western Village	Water	~200	$620,000	TDRA	To be complete in 2010
El Paso County/ EPWU	Mayfair/ NuWay	Water	~800	$2,000,000	USDA-RD	Anticipate 2011/2012 completion
El Paso County/ EPWU	Schuman Estates	Water	~200	$1,200,000	USDA-RD	Anticipate 2011/2012 completion
EPWU	Turf Estates	Water	~500	$1,100,000	TWDB	Application being reviewed
EPWU	Canutillo	Water	~400	$2,300,000	TWDB	Application being reviewed
El Paso County/ EPWU	Montana Vista	Wastewater	~2,500	$20,000,000	TWDB	Planning grant application drafted
Lower Valley Water District Horizon MUD	Sand Hills and Other Areas	Water	~1,000	TBD	USDA-RD, Others	Under consideration

1.11 INTERNATIONAL WATER ISSUES

1.11.1 Ciudad Juarez

Ciudad Juarez is located across the Rio Grande from the City of El Paso and currently is 100 percent dependent on the Hueco Bolson and Conejos Medanos Aquifers to satisfy all of its municipal and industrial demands. Pumping from the Hueco by Ciudad Juarez since 2000 is summarized in Table 1-5.

Table 1-5. Ciudad Juarez Hueco Groundwater Pumping (Acre-Feet/Year)

Year	Groundwater Pumping
2000	126,172
2001	124,735
2002	124,676
2003	125,144
2004	119,420
2005	122,314
2006	126,654
2007	129,193
2008	132,888
2009	131,655
2010	133,681
2011	136,111
2012	137,732
2013	141,783
2014	144,213

Pumping continues to increase each year in response to the population rise. However, water conservation efforts in Ciudad Juarez have somewhat offset increased population and service connections. With a growing population that is currently estimated to be over 1.5 million, Ciudad Juarez recognizes the limitations of the Hueco Bolson to supply future demands. Future supplies are anticipated from the following “imported” groundwater sources:

- Bismark Mine (26,000 acre-feet/year)
- Mesilla (26,000 acre-feet/year)
- Somero (28,000 acre-feet/year)
- Profundo (31,000 acre-feet/year)

In addition, plans are also being developed to convert 38,000 acre-feet/year of surface water from the Rio Grande (Rio Bravo) for use as municipal supply. Currently, Mexico’s allocation from the Rio Grande Project of 60,000 acre-feet/year is used for irrigated agriculture. The conversion would involve supplying wastewater effluent to farmers in exchange for surface water.

1.11.2 City of El Paso

El Paso manages the Hueco Bolson Aquifer as a drought supply. When surface water is not available (typically the winter and spring months) the aquifer is heavily pumped, becoming a major source of water for the east side of El Paso. However, when surface water is available, pumping from the Hueco Bolson Aquifer decreases.

EPWU has consistently decreased its groundwater dependence on the Hueco Bolson with its increased use of surface water (Rio Grande), reclaimed water, and water conservation. However, during periods of severe river drought, groundwater pumpage from the Hueco Bolson including the KBH desalination plant will be increased dramatically to offset the limited river supply.

In 2013, surface water availability was only 10,000 acre-feet (from the Rio Grande) due to severe drought conditions. As a result, the Hueco production was maximized. Although drought conditions have improved, surface water is limited, causing the Hueco Bolson Aquifer to remain a critical groundwater supply source.

1.11.3 Transboundary Effects of Groundwater Pumpage

Prior to 1960, up to 5,000 acre-feet/year of groundwater flowed underground from Mexico to Texas as a result of higher pumping in El Paso than in Ciudad Juarez. However, since 1960, groundwater has generally flowed from Texas into Mexico due to increases in Ciudad Juarez pumping. The rate of flow has been about 33,000 acre-feet/year over the last decade. With continuous pumping from both Ciudad Juarez and El Paso, both cites have experienced extensive water-level drawdowns and water-quality degradation due to lateral brackish water intrusion into the fresh water zones. Brackish water intrusion from irrigation return flow drains continues to expand laterally and vertically, and to degrade water quality in the shallow alluvium along the Rio Grande.

1.12 STATE AND FEDERAL AGENCIES WITH WATER RESPONSIBILITIES

1.12.1 Texas Water Development Board (TWDB)

The TWDB (http://www.twdb.texas.gov/) especially the Water Resources Planning and Information Division, is at the center of the Senate Bill 1 regional water planning effort. The agency has been given the responsibility of directing the effort in order to ensure consistency and to guarantee that all regions of the State submit plans in a timely manner. Results of the 16 regional water plans are then incorporated by the TWDB into a State Water Plan. The TWDB also administers financial grant and loan programs that provide funding for water research and facility planning projects.

1.12.2 Texas Commission on Environmental Quality (TCEQ)

The TCEQ (http://www.tceq.texas.gov/) 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. 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.

1.12.3 Texas Parks and Wildlife Department (TPWD)

The TPWD (http://www.tpwd.state.tx.us/) mission is to manage and conserve the natural and cultural resources of Texas and to provide hunting, fishing and outdoor recreation opportunities for the use and enjoyment of present and future generations. The agency currently has six program divisions: Wildlife, Coastal Fisheries, Inland Fisheries, Law Enforcement, State Parks, and Infrastructure.

1.12.4 Texas Department of Agriculture (TDA)

The TDA (http://www.texasagriculture.gov/Home.aspx) 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, nationally, 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.

1.12.5 Texas State Soil and Water Conservation Board (TSSWCB)

The TSSWCB (http://www.tsswcb.texas.gov/) is charged with the overall responsibility for administering the coordination of 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.

1.12.6 International Boundary and Water Commission (IBWC) and Comisión Internacional de Límites y Aquas (CILA)

The IBWC (http://ibwc.state.gov/) and 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.

1.12.7 United States Bureau of Reclamation (USBR)

The stretch of the Rio Grande from Elephant Butte Dam (approximately 100 miles north of El Paso) to Fort Quitman, Texas, is within a federal reclamation project known as the Rio Grande Project. The Bureau of Reclamation manages (http://www.usbr.gov/) the Elephant Butte Dam and the Caballo Reservoir in New Mexico, and determines the amount and timing of all water releases to Texas, with the input of the El Paso County Water Improvement District #1. The Bureau is guided by the terms of the Rio Grande Compact. The Bureau has asserted title to all of the water in the Project in a lawsuit styled United States v. EBID, et al, which is currently being litigated.

1.12.8 United States Geological Survey (USGS)

The USGS (http://www.usgs.gov/) is responsible for fulfilling the Nation's needs for reliable, impartial scientific information to describe and understand the Earth. This information is used to minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect the quality of life. The USGS is the Federal Government's principal civilian map-making agency; the primary source of its data on the quality and quantity of the Nation's water resources; the Nation's primary provider of earth-science information on natural hazards, mineral and energy resources, and the environment; and the major partner in developing the Nation's understanding of the status and trends of biological resources and the ecological factors affecting living resources.

1.12.9 United States Environmental Protection Agency (EPA)

The mission of the EPA (http://www.epa.gov/) is to protect human health and the environment. Programs of the EPA are designed to (1) 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.

1.12.10 United States Fish and Wildlife Service (USFWS)

The USFWS (http://www.fws.gov/) 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.

1.13 LOCAL ORGANIZATIONS AND UNIVERSITIES

The public and even those involved in water planning and management find it difficult to know about or keep track of the large number and wide array of organizations involved with water resource issues in Far West Texas. Following is a list of a number of these organizations. Because of the hydrologic, cultural and economic connections of Far West Texas with Southern New Mexico and Mexico, this list includes water organizations in this expanded region. The list is likely incomplete as there are certainly other organizations deserving of being included.

Alliance for the Rio Grande Heritage

Border Environmental Cooperation Commission

City of El Paso

- Water Conservation Advisory Board
- Rio Grande Riverpark Task Force

City Of Las Cruces

- Rio Grande Riparian Ecological Corridor Project

Consortium for Hi-Technology Investigations in Water and Waste Water

Environmental Defense

Forest Guardians

Hudspeth Directive for Conservation

- New Mexico State University
- New Mexico Lower Rio Grande Regional Water Users Organization
- New Mexico Water Conservation Alliance
- New Mexico Water Resources Research Institute
- New Mexico Water Task Force
- WERC: A Consortium for Environmental Education and Technology Development

New Mexico Water Trust Board

North American Commission for Environmental Cooperation

New Mexico-Texas Water Commission

North American Development Bank

Paso Del Norte Watershed Council

Paso Del Norte Water Task Force

Project Del Rio

Rio Grande/Rio Bravo Basin Coalition

Rio Grande Council Of Governments

Rio Grande Institute

Rio Grande Watershed Federal Coordinating Committee

Southwest Environmental Center

The Texas A&M University System

- Texas AgriLife Research Center in El Paso
- Texas Cooperative Extension
- Rio Grande Basin Initiative
- Texas Water Resources Institute

Texas State University System

- Sustainable Agricultural Water Conservation in the Rio Grande
- Basin Project

Texas Water Matters

- Lone Star Chapter of the Sierra Club
- National Wildlife Federation
- Environmental Defense

Tularosa Basin National Desalination Research Facility

University of Texas at El Paso

- Center for Environmental Resource Management
- Rio Bosque Wetlands Park
- Southwest Consortium for Environmental Research and Policy of the Southwest

U. S. Mexico Border Coalition of Resource Conservation and Development Councils

World Wildlife Fund – Chihuahuan Desert Program

CHAPTER 2
POPULATION AND WATER DEMAND

This page intentionally left blank.

2 POPULATION AND WATER DEMAND

Planning for the wise use of the existing water resources in Far West Texas requires a reasonable estimation of current and future water needs for all water-use categories. Regional population and water demand data were initially provided to the Far West Texas Water Planning Group (FWTWPG) at the beginning of the planning period. This information incorporated data from the State Data Center and from the U.S. Bureau of the Census' 2010 census count. The FWTWPG reviewed the provided projections and concluded that the data were satisfactory for use in this current regional water plan.

2.1 POPULATION

2.1.1 Population Projection Methodology

County population projections are based on Texas State Data Center / Office of the State Demographer county-level population projections. These projections are based on recent and projected demographic trends, including birth and survival rates and net migration rates of population groups defined by age, gender, and race/ethnicity. The projected county population is then allocated to cities with a 2010 population greater than 500. In some cases, the water user group (WUG) is a utility. In these cases, the population reported for the utility represents the population served by that utility. The rural "County Other" population is calculated as the difference between the total projected population of the cities and the total projected county population. Population is then projected from the 2010 base year by decade to the 2070 decade. A more detailed explanation of the TWDB population projection methodology is available at http://www.twdb.texas.gov/waterplanning/data/projections/index.asp.

2.1.2 Current and Projected Population

Although the FWTWPG was mandated to use the 2010 census numbers for the purposes of calculating current and projected population, representatives from both urban and rural areas expressed concerns that the census represents a significant undercount of actual residents in the Region. This is especially true in the rural areas, where serious flaws existed with the U.S. Census Bureau's information-gathering techniques. 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.

Current and projected population by decade for communities, water utilities, and county rural areas in Far West Texas is listed in Table 2-1. The year-2020 projected population for the entire Region is 954,035 of which 97 percent reside in El Paso County and 77 percent in the City of El Paso (Figure 2-1). The regional population is projected to increase to 1,551,438 by the year 2070, which is an increase of 597,403 citizens. Most of this increase (591,775) is projected to occur in El Paso County (Figure 2-2 and Figure 2-3).

Table 2-1. Far West Texas Population Projections (Rio Grande River Basin)
(Acre-Feet per Year)

	2020	2030	2040	2050	2060	2070
Brewster County						
Alpine	6,066	6,185	6,231	6,265	6,283	6,293
County-Other	3,661	3,906	3,999	4,069	4,104	4,124
Brewster County Total Population	9,727	10,091	10,230	10,334	10,387	10,417
Culberson County						
Van Horn	2,319	2,542	2,641	2,730	2,782	2,815
County-Other	376	412	428	443	451	457
Culberson County Total Population	2,695	2,954	3,069	3,173	3,233	3,272
El Paso County						
Anthony	6,210	7,461	8,623	9,774	10,864	11,889
Clint	926	926	926	926	926	926
El Paso	734,031	822,625	904,900	986,455	1,063,672	1,136,275
El Paso County Tornillo WID	2,790	2,802	2,814	2,825	2,836	2,846
El Paso WCID #4	8,858	9,131	9,385	9,636	9,874	10,098
Fort Bliss	8,929	9,282	9,610	9,935	10,242	10,531
Horizon City	28,607	40,995	52,499	63,902	74,699	84,851
Horizon Regional MUD	24,522	34,026	42,852	51,600	59,883	67,671
Lower Valley WD	33,186	42,193	50,558	58,849	66,699	74,080
Socorro	37,031	42,267	47,129	51,949	56,512	60,803
Vinton	2,053	2,139	2,219	2,298	2,373	2,443
County-Other	38,422	42,056	45,430	48,778	51,947	54,927
El Paso County Total Population	925,565	1,055,903	1,176,945	1,296,927	1,410,527	1,517,340
Hudspeth County						
Sierra Blanca	620	680	699	713	720	724
County-Other	3,293	3,624	3,725	3,798	3,833	3,851
Hudspeth County Total Population	3,913	4,304	4,424	4,511	4,553	4,575
Jeff Davis County						
Fort Davis	1,264	1,264	1,264	1,264	1,264	1,264
County-Other	1,134	1,134	1,134	1,134	1,134	1,134
Jeff Davis County Total Population	2,398	2,398	2,398	2,398	2,398	2,398
Presidio County						
Marfa	2,203	2,394	2,578	2,781	2,962	3,134
Presidio	4,867	5,247	5,615	6,018	6,379	6,722
County-Other	1,622	1,804	1,981	2,173	2,347	2,511
Presidio County Total Population	8,692	9,445	10,174	10,972	11,688	12,367
Terrell County						
Sanderson	889	910	910	910	910	910
County-Other	156	159	159	159	159	159
Terrell County Total Population	1,045	1,069	1,069	1,069	1,069	1,069
Region E Total Population	**954,035**	**1,086,164**	**1,208,309**	**1,329,384**	**1,443,855**	**1,551,438**

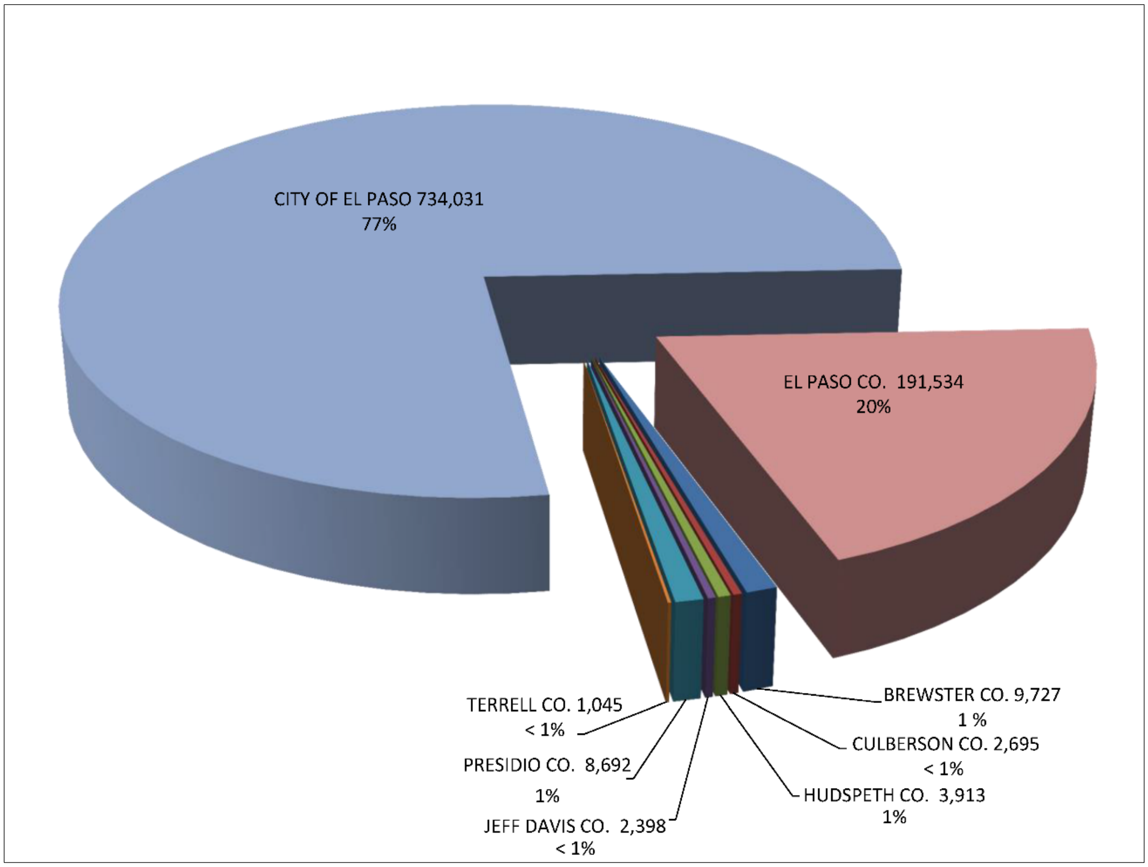


Figure 2-1. Year 2020 Projected Population

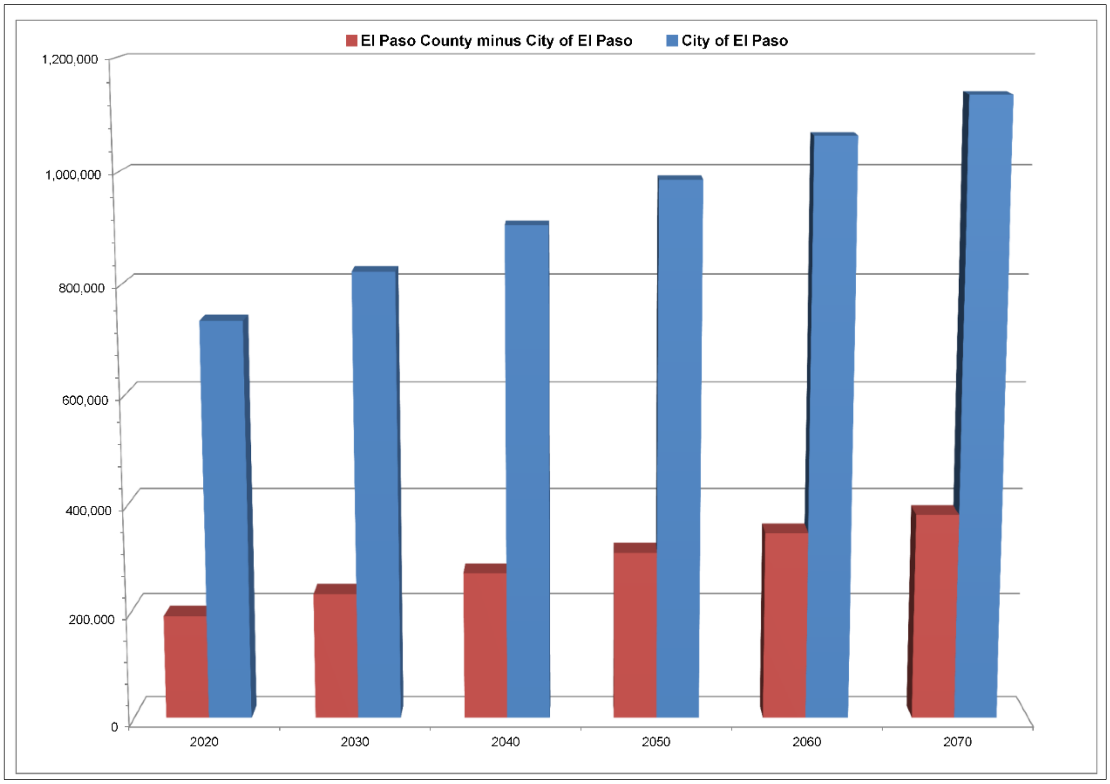


Figure 2-2. Population Projection Distribution in El Paso County

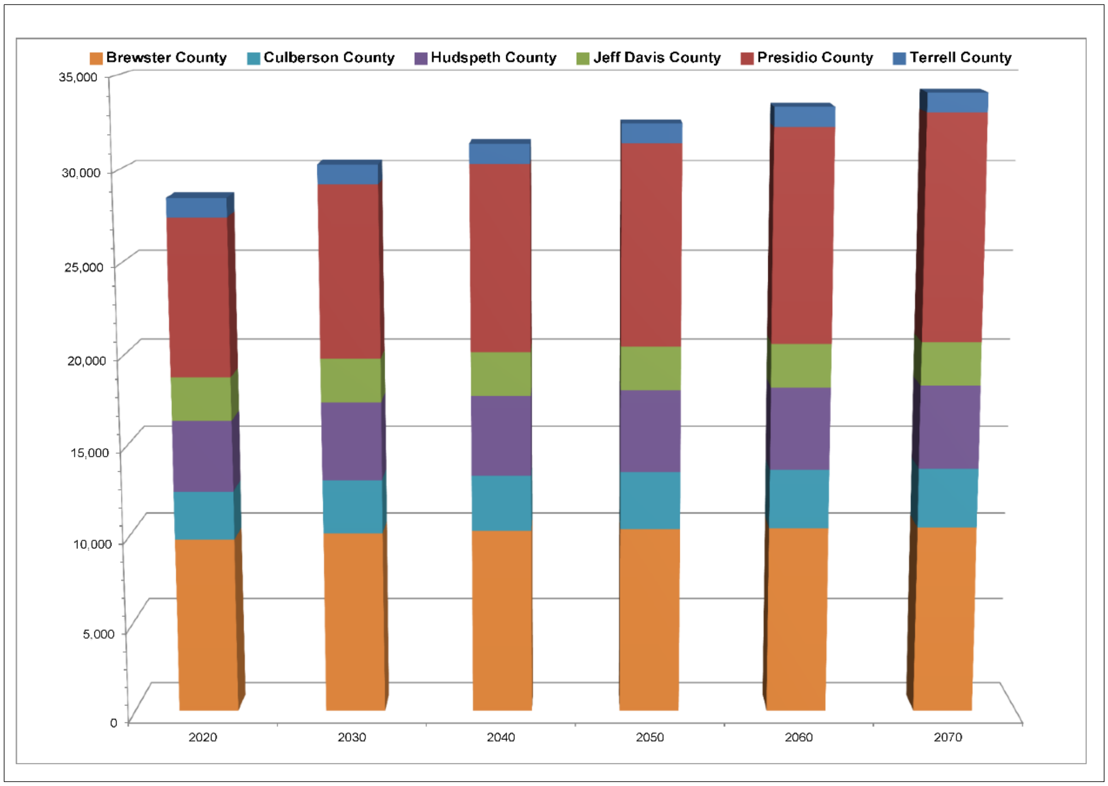


Figure 2-3. Population Projection Distribution in Rural Counties

2.2 WATER DEMAND

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) steam-electric power generation, (6) livestock, and (7) mining. Table 2-2 lists the current and future projected regional water demands by county and water-use category. The percent distribution of year-2020 projected water demand in the Region by the seven water-use categories is shown in Figure 2-4 and by county in Figure 2-5. Other water use categories that are not quantified in this *Plan* but are addressed (Section 2.3) include environmental and recreational needs. An additional use that is not quantified but may be of significance is water that is used in road construction for both compaction and dust suppression.

Figure 2-6 illustrates current and future projected regional water demand estimates by water-use category, while Figure 2-7 illustrates water demand projections by county. For the 2020 to 2070 decades the total water demand in the Region is projected to increase from 645,404 to 693,597 acre-feet per year.

The potential role of conservation is an important factor in projecting future water supply requirements. Water demands listed in the *2011 Far West Texas Water Plan* included demand adjustments based on expected conservation practices. In this *2016 Plan,* conservation is only 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 strategies in Chapter 5 and as a component of drought management plans in Chapter 7. The following sections present an overview of water supply needs for wholesale water providers 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. Far West Texas Water Demand Projections (Rio Grande River Basin)
(Acre Feet per Year)

	2020	2030	2040	2050	2060	2070
Brewster County						
Alpine	1,935	1,944	1,936	1,934	1,937	1,940
County-Other	563	583	584	588	591	594
Manufacturing	4	4	4	4	4	4
Livestock	386	386	386	386	386	386
Irrigation	2,304	2,293	2,280	2,269	2,258	2,247
Brewster County Total Demand	5,192	5,210	5,190	5,181	5,176	5,171
Culberson County						
Van Horn	662	711	737	761	775	784
County-Other	65	70	71	73	74	75
Mining	506	1,240	1,393	1,110	843	640
Livestock	300	300	300	300	300	300
Irrigation	39,928	39,074	38,238	37,420	36,619	35,835
Culberson County Total Demand	41,461	41,395	40,739	39,664	38,611	37,634
El Paso County						
Anthony	734	852	965	1,083	1,201	1,313
Clint	92	88	84	83	83	83
El Paso	110,573	120,315	129,713	139,978	150,602	160,792
El Paso County Tornillo WID	279	272	267	264	264	265
EL Paso WCID #4	811	793	781	783	799	817
Fort Bliss	1,648	1,662	1,696	1,750	1,800	1,850
Horizon City	4,458	6,309	8,047	9,775	11,414	12,959
Horizon Regional MUD	3,673	5,022	6,291	7,555	8,757	9,891
Lower Valley WD	3,574	4,349	5,086	5,855	6,621	7,348
Socorro	3,176	3,447	3,716	4,028	4,365	4,691
Vinton	248	254	260	267	275	283
County-Other	6,646	7,042	7,498	8,032	8,537	9,023
Manufacturing	16,138	17,265	18,355	19,282	20,758	22,347
Mining	4,008	4,626	5,262	5,948	6,693	7,539
Steam Electric Power	6,937	8,111	9,541	11,284	13,410	15,937
Livestock	629	629	629	629	629	629
Irrigation	242,798	240,848	232,380	228,579	224,840	221,162
El Paso County Total Demand	406,422	421,884	430,571	445,175	461,048	476,929
Hudspeth County						
Sierra Blanca	151	162	165	167	168	169
County-Other	347	365	363	364	366	368
Manufacturing	2	2	2	2	2	2
Mining	479	451	468	483	492	502
Livestock	541	541	541	541	541	541
Irrigation	178,840	175,132	171,501	167,945	164,463	161,053
Hudspeth County Total Demand	180,360	176,653	173,040	169,502	166,032	162,635
Jeff Davis County						
Fort Davis	297	292	288	286	285	285
County-Other	168	163	158	156	155	155
Livestock	495	495	495	495	495	495
Irrigation	2,560	2,547	2,534	2,521	2,504	2,490
Jeff Davis County Total Demand	3,520	3,497	3,475	3,458	3,439	3,425

Table 2-2. (Continued) Far West Texas Water Demand Projections (Rio Grande River Basin)
(Acre Feet per Year)

	2020	2030	2040	2050	2060	2070
Presidio County						
Marfa	589	627	667	718	764	808
Presidio	659	689	721	764	808	851
County-Other	249	267	287	313	338	361
Mining	403	0	0	0	0	0
Livestock	408	408	408	408	408	408
Irrigation	4,630	4,539	4,450	4,363	4,278	4,197
Presidio County Total Demand	6,938	6,530	6,533	6,566	6,596	6,625
Terrell County						
Sanderson	202	202	200	199	199	199
County-Other	19	19	19	19	19	19
Mining	673	776	740	606	483	385
Livestock	238	238	238	238	238	238
Irrigation	379	369	359	354	344	337
Terrell County Total Demand	1,511	1,604	1,556	1,416	1,283	1,178
Region E Total Demand	**645,404**	**656,773**	**661,104**	**670,962**	**682,185**	**693,597**

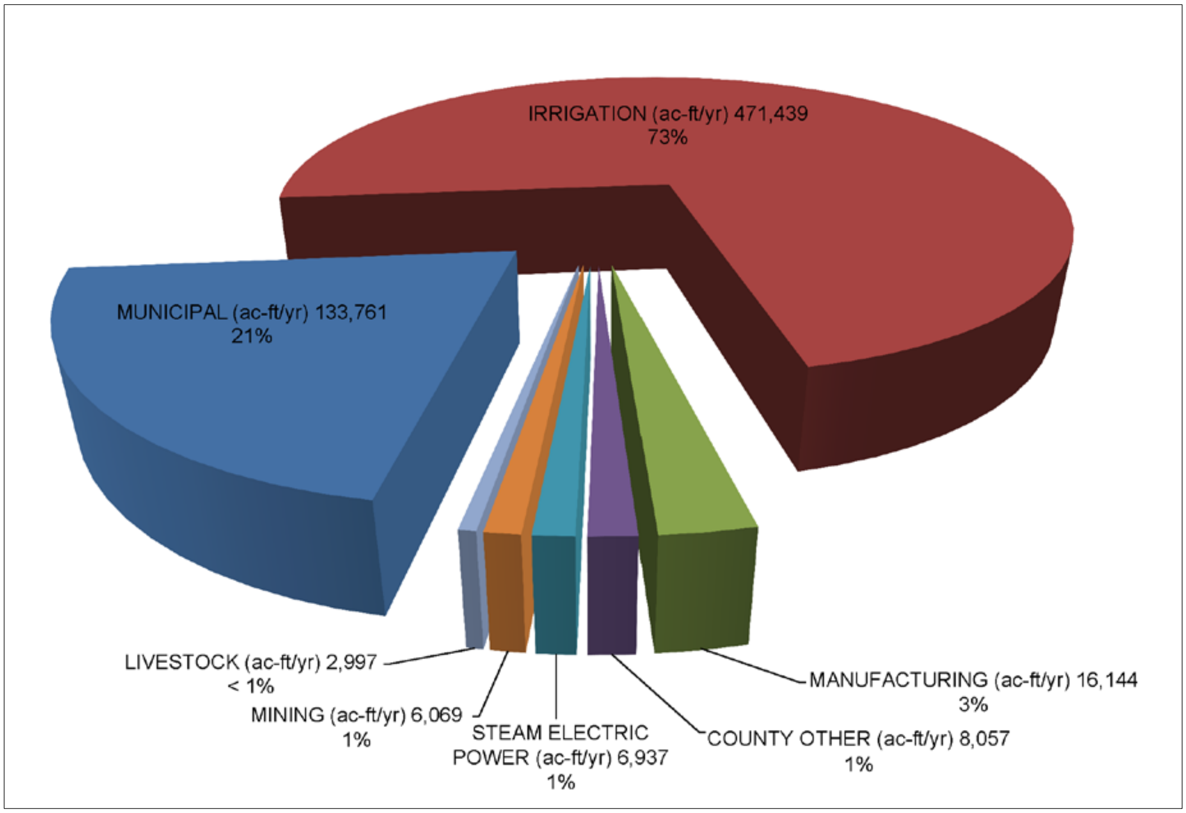


Figure 2-4. Year 2020 Projected Water Demand by Water-Use Category

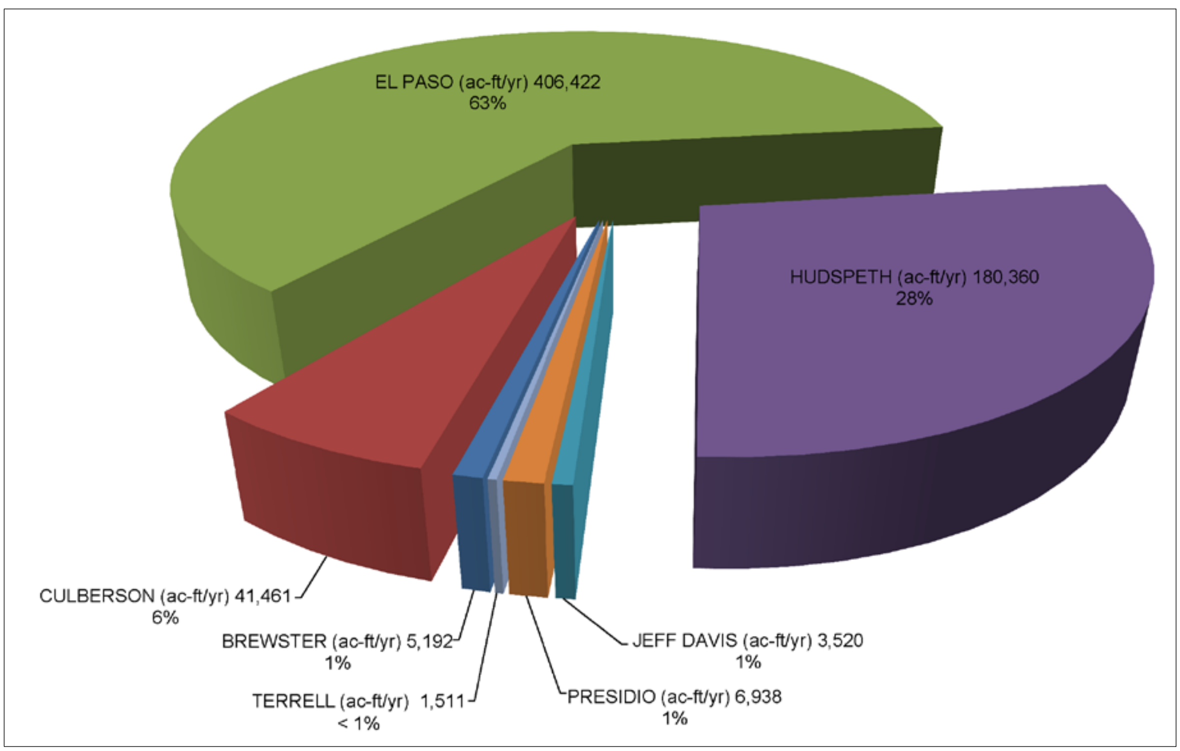


Figure 2-5. Year 2020 Projected Water Demand by County

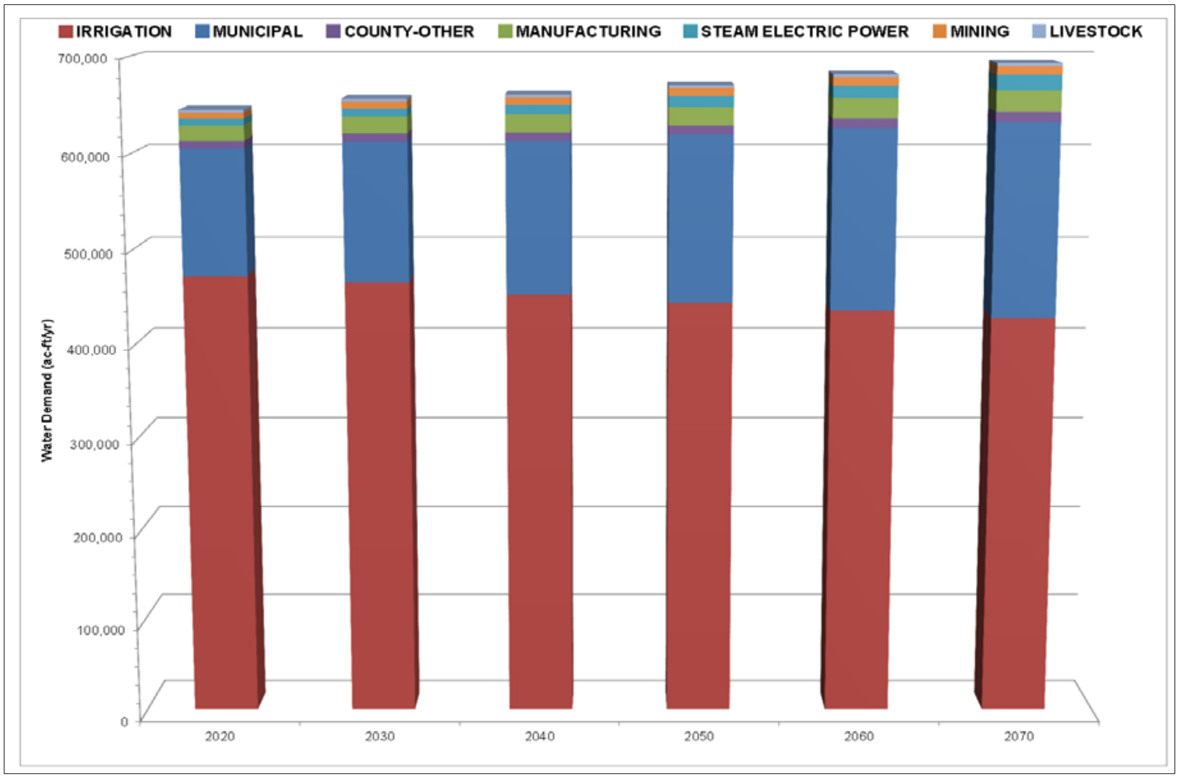


Figure 2-6. Regional Projected Water Demand by Water Use Category

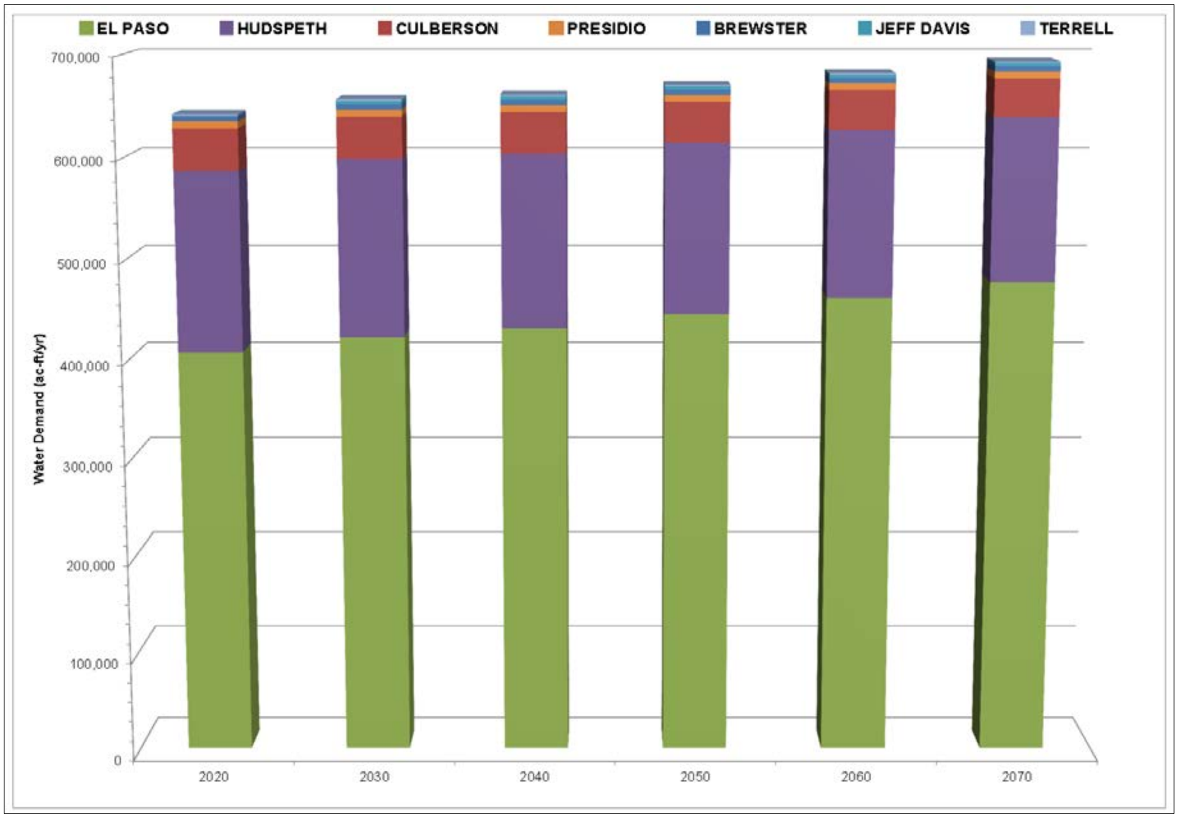


Figure 2-7. Regional Projected Water Demand by County

2.2.1 Wholesale Water Providers

A wholesale water provider is defined as any entity that had contracts to sell more than 1,000 acre-feet of water wholesale in any one year during the five years immediately preceding the adoption of the last Far *West Texas Water Plan (2011)*, or that is expected to enter into contracts to sell more than 1,000 acre-feet of water per year wholesale during the period covered by this *Plan* (2011–2016). Table 2-3 lists wholesale water providers in Far West Texas and their customers.

Table 2-3. Far West Texas Wholesale Water Provider Water Demand

Wholesale Water Provider	Receiving Entity	Water Demand (Acre-Feet/Year)					
		2020	2030	2040	2050	2060	2070
El Paso County WID#1	El Paso Water Utilities (33%)	48,620	53,002	57,333	62,033	67,127	72,196
	El Paso County Irrigation	242,798	240,848	232,380	228,579	224,840	221,162
	Total Demand	**291,418**	**293,850**	**289,713**	**290,612**	**291,967**	**293,358**
El Paso Water Utilities	City of El Paso	110,573	120,315	129,713	139,978	150,602	160,792
	Fort Bliss (73%)	1,203	1,213	1,238	1,278	1,314	1,351
	Lower Valley Water District	6,842	7,884	8,886	9,966	11,069	12,122
	Vinton	248	254	260	267	275	283
	Manufacturing	16,138	17,265	18,355	19,282	20,758	22,347
	Mining (12%)	481	555	631	714	803	905
	Steam Electric Power (75%)	5,203	6,083	7,156	8,463	10,058	11,953
	County Other	6,646	7,042	7,498	8,032	8,537	9,023
	Total Demand	**147,334**	**160,611**	**173,737**	**187,980**	**203,416**	**218,776**
Lower Valley Water District	Socorro	3,176	3,447	3,716	4,028	4,365	4,691
	Clint	92	88	84	83	83	83
	San Elizario and Other Retail Customers	3,574	4,349	5,086	5,855	6,621	7,348
	Total Demand	**6,842**	**7,884**	**8,886**	**9,966**	**11,069**	**12,122**
Horizon Regional MUD	Horizon City	4,458	6,309	8,047	9,775	11,414	12,959
	Other Retail Customers	3,673	5,022	6,291	7,555	8,757	9,891
	Total Demand	**8,131**	**11,331**	**14,338**	**17,330**	**20,171**	**22,850**

2.2.2 Municipal and County-Other

The quantity of water used for municipal and county-other (rural domestic) purposes is heavily dependent on population, 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 applied to municipally owned golf courses. Water use within a city limit that is not included in the quantification of municipal demand is that used in manufacturing and industrial processes.

Municipal and county-other water demand is calculated for the communities and utilities designated in the population projections process and include rural domestic use. Projected municipal water demand is based on the year-2010 per-capita water use, which is calculated with year-2010 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 for commercial customers, will appear abnormally high. The year-2010 per-capita water use is reduced slightly over time to simulate expected conservation savings due to state-mandated plumbing code implementation. 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.

Rural communities (outside of El Paso County) are relatively small and are generally reliant on self-provided water supplies. Water demand within these communities is related directly to their population trends and is thus relatively stable or moderately increasing over the next 50 years. Projected water-demand growth for the numerous communities within El Paso County is significantly greater and thus will require a level of coordinated intercommunity planning.

Table 2-4. Municipal and County-Other Water Use Projections
(Acre Feet per Year)

County	2020	2030	2040	2050	2060	2070
Brewster	2,498	2,527	2,520	2,522	2,528	2,534
Culberson	727	781	808	834	849	859
El Paso	135,912	150,405	164,404	179,453	194,718	209,315
Hudspeth	498	527	528	531	534	537
Jeff Davis	465	455	446	442	440	440
Presidio	1,497	1,583	1,675	1,795	1,910	2,020
Terrell	221	221	219	218	218	218

A significant portion of the municipal water demand in Brewster, Jeff Davis, and Presidio Counties is assigned to the county-other (rural) category. This category includes small communities of less than 500 population, rural water utilities, and privately owned well use. Listed below are examples of some of the active public water suppliers (restaurants and motels not included) in these counties that fall into the County-other category.

Brewster County

Big Bend National Park
Marathon WS&SC
Lajitas Resort
Study Butte Terlingua WS
Terlingua Ranch Development
Twin Peaks Mobile Home Park

Jeff Davis County

Camp Miter Peak
Chihuahuan Desert Research Institute
City of Valentine
Davis Mountains State Park (TPWD)
Fort Davis Estates
Fort Davis WSC
High Frontier
Prude Ranch
Skyline Drive (TPWD)
UT McDonald Observatory
Valentine ISD
Village Farms (Fort Davis)

Presidio County

Big Bend Ranch State Park (TPWD)
Candelaria WSC
Cibolo Creek Ranch
Fort Leaton SHP (TPWD)
Howard Water Supply
Redford School
Redford Water Supply
USAF TARS
Village Farms (Marfa)

Municipal water demands incorporate anticipated future water savings due to the natural instillation of plumbing fixtures and appliances to more water-efficient fixtures and appliances (Table 2-5).

Table 2-5. Municipal Savings Due to Plumbing Fixture Requirements
(Acre-Feet per Year)

County	Entity Name	2020	2030	2040	2050	2060	2070
Brewster	Alpine	63	93	117	130	133	133
Brewster	County-Other, Brewster	40	60	75	83	85	85
Culberson	County-Other, Culberson	4	6	8	9	9	9
Culberson	Van Horn	29	47	50	53	55	56
El Paso	Anthony	66	109	146	177	199	219
El Paso	Clint	10	14	18	19	19	19
El Paso	County-Other, El Paso	456	732	899	984	1,065	1,130
El Paso	El Paso	7,828	12,375	16,248	19,138	20,970	22,490
El Paso	El Paso County Tornillo WID	24	33	39	43	44	45
El Paso	El Paso WCID #4	93	138	176	200	208	213
El Paso	Fort Bliss	103	158	188	198	208	214
El Paso	Horizon City	220	396	539	676	802	918
El Paso	Horizon Regional MUD	201	353	477	595	701	797
El Paso	Lower Valley WD	404	708	974	1,198	1,374	1,532
El Paso	Socorro	392	625	824	977	1,080	1,167
El Paso	Vinton	17	22	26	29	31	32
Hudspeth	County-Other, Hudspeth	37	58	71	79	81	81
Hudspeth	Siera Blanca	7	11	14	15	15	15
Jeff Davis	County-Other, Jeff Davis	12	17	22	24	24	24
Jeff Davis	Fort Davis	13	17	21	24	24	24
Presidio	County-Other, Presidio	19	30	40	45	49	53
Presidio	Marfa	26	41	53	58	63	67
Presidio	Presidio	50	75	97	113	122	129
Terrell	County-Other, Terrell	2	3	3	3	3	3
Terrell	Sanderson	10	15	18	18	19	19
Total		**10,125**	**16,139**	**21,144**	**24,888**	**27,383**	**29,474**

2.2.3 Manufacturing

Draft manufacturing water demand projections utilized 2004-2008 data from TWDB's Water Use Survey (WUS). In counties where reported employment from the companies returning surveys was low compared to manufacturing employment data reported by the Bureau of Economic Analysis (BEA), surveyed water use was adjusted to account for non-responses. The rate of change for projections from the 2011 Regional Water Plans was then applied to the new base year estimate.

The use of water for manufacturing purposes only occurs in Brewster, El Paso and Hudspeth Counties (Table 2-6). Use in Brewster and Hudspeth Counties is minimal and is not anticipated to change significantly over time, however, manufacturing water use in El Paso County is expected to increase from 16,138 acre-feet in the year 2020 to 22,345 acre-feet by 2070. While a portion of this water is self-supplied, most will be purchased from various water supply entities, principally El Paso Water Utilities.

Table 2-6. Manufacturing Water Use Projections
(Acre Feet per Year)

County	2020	2030	2040	2050	2060	2070
Brewster	4	4	4	4	4	4
Culberson	0	0	0	0	0	0
El Paso	16,138	17,265	18,355	19,282	20,758	22,347
Hudspeth	2	2	2	2	2	2
Jeff Davis	0	0	0	0	0	0
Presidio	0	0	0	0	0	0
Terrell	0	0	0	0	0	0

2.2.4 Irrigation

Draft irrigation water demand projections utilized an average of TWDB's 2005-2009 irrigation water use estimates as a base. 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 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. The rate of change for projections from the 2011 Regional Water Plans was then applied to the new base.

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.

Water used for agricultural irrigation in Far West Texas is significantly greater (76 percent of total) than all other water-use categories. On a regional basis, water used for the irrigation of crops is projected to decline slightly 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 quantity and quality of water needed for agricultural irrigation is dependent on the type of crop grown and on soil characteristics. Although a minimal amount of agriculture can persist on limited water supplies, most crops require significantly larger water applications to remain profitable. Irrigated farms along the Rio Grande corridor in El Paso and Hudspeth Counties are almost entirely dependent on water supplies derived from the River. When Rio Grande water is limited or not available, most farming temporarily ceases until water supplies once again become available. Irrigated farms in other areas within the Region are dependent on groundwater supplies. Availability of these supplies depends on local pumping regulatory limitations, aquifer hydrologic characteristics, and energy cost.

Irrigation strategies principally involve various forms of conservation. Irrigation application equipment has been developed to insure that greater amounts of applied water reach the root system while minimizing loss to evaporation. Proper application timing is also critical in avoiding over-watering. The lining of canals that transport water from its source to the fields reduces losses due to seepage. Drought tolerant crop selection is also important when faced with limited water supplies.

Some farmers across the Region are using slightly-saline water for irrigation. In order to maintain long-term soil productivity with saline waters, producers must over irrigate to maintain a leaching fraction that minimizes salt buildup in the crop root zone. In some areas, high levels of sodium have reduced soil infiltration rates. Producers often manage this problem through application of soil amendments (such as gypsum or organic residues) or through mechanical mixing of the soil. Table 2-7 presents the projected irrigation water use for all decades in the current water planning cycle.

Table 2-7. Irrigation Water Use Projections
(Acre Feet per Year)

County	2020	2030	2040	2050	2060	2070
Brewster	2,304	2,293	2,280	2,269	2,258	2,247
Culberson	39,928	39,074	38,238	37,420	36,619	35,835
El Paso	242,798	240,848	232,380	228,579	224,840	221,162
Hudspeth	178,840	175,132	171,501	167,945	164,463	161,053
Jeff Davis	2,560	2,547	2,534	2,521	2,504	2,490
Presidio	4,630	4,539	4,450	4,363	4,278	4,197
Terrell	379	369	359	354	344	337

2.2.5 Steam Electric Power Generation

Draft steam-electric power generation water demand projections are based on projections from the 2011 Regional Water Plans and the 2008 TWDB report *Water Demand Projections for Power Generation in Texas*. Recent data from the Public Utilities Commission of Texas on plant announcements, retirements, and capacity changes were incorporated to adjust the base. The rate of change for projections from the 2011 Regional Water Plans was then applied to the new base.

El Paso Electric located in El Paso County is the only facility within the Region that uses water in the form of steam to generate electricity (Table 2-8). Anticipated local population growth, as well as increasing commercial and manufacturing power needs, means that the quantity of water needed to produce electricity will likewise increase. El Paso Electric currently purchases most of its water supply from El Paso Water Utilities.

Table 2-8. Steam Electric Power Generation Water Use Projections
(Acre Feet per Year)

County	2020	2030	2040	2050	2060	2070
Brewster	0	0	0	0	0	0
Culberson	0	0	0	0	0	0
El Paso	6,937	8,111	9,541	11,284	13,410	15,937
Hudspeth	0	0	0	0	0	0
Jeff Davis	0	0	0	0	0	0
Presidio	0	0	0	0	0	0
Terrell	0	0	0	0	0	0

2.2.6 Livestock

Texas is the nation's leading livestock producer, accounting for approximately 11 percent of the total United States production. Although livestock production is an important component of the Texas economy, the industry consumes a relatively small amount of water.

Draft livestock water demand projections utilized an average of TWDB’s 2005-2009 livestock water use estimates as the base. Water use estimates are calculated by applying a water use coefficient for each livestock category to county level inventory estimates from Texas Agricultural Statistics Service. The rate of change for projections from the 2011 Regional Water Plans was then applied to the new base. Many counties chose to hold the base constant throughout the planning horizon.

For water-supply planning purposes, livestock water use 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. Table 2-9 presents the projected livestock water use for the Region.

Table 2-9. Livestock Water Use Projections
(Acre Feet per Year)

County	2020	2030	2040	2050	2060	2070
Brewster	386	386	386	386	386	386
Culberson	300	300	300	300	300	300
El Paso	629	629	629	629	629	629
Hudspeth	541	541	541	541	541	541
Jeff Davis	495	495	495	495	495	495
Presidio	408	408	408	408	408	408
Terrell	238	238	238	238	238	238

2.2.7 Mining

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.

Draft mining water demand projections were developed through a TWDB-contracted study with the Bureau of Economic Geology (BEG). The BEG study estimated current mining water use and projected that use across the planning horizon using data collected from trade, organizations, government agencies, and other industry representatives. County-level projections are compiled as the sum of individual projections for four sub-sector mining categories: oil and gas, aggregates, coal and lignite, and other.

Much of the water used in the mining industry in Far West Texas (Table 2-10) is related to its use in the quarrying of gravel and road base materials. However, the largest single water use occurs in Culberson County where it is employed in the mining of talc mineral aggregates.

In recent years, increased oil and gas exploration activity has occurred in the Region, especially in Terrell County where Railroad Commission of Texas files list 460 wells drilled in the county from 1999 through 2008.

Table 2-10. Mining Water Use Projections
(Acre Feet per Year)

County	2020	2030	2040	2050	2060	2070
Brewster	0	0	0	0	0	0
Culberson	506	1,240	1,393	1,110	843	640
El Paso	4,008	4,626	5,262	5,948	6,693	7,539
Hudspeth	479	451	468	483	492	502
Jeff Davis	0	0	0	0	0	0
Presidio	403	0	0	0	0	0
Terrell	673	776	740	606	483	385

2.3 ENVIRONMENTAL AND RECREATIONAL WATER NEEDS

Environmental and recreational water use in Far West Texas 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 eco-recreational resources are identified and described. In the following paragraphs, the water resources needed to maintain these functions is discussed. Water-supply sources that serve environmental needs, along with identified major springs, are characterized in Chapter 3, and potential water-supply strategy impacts on the environment are considered in Chapter 5. Chapter 8 contains a discussion and recommendations pertaining to "Ecologically Unique River and Stream Segments."

In terms of combined area, Far West Texas contains most of the federal public land in Texas, and over half the land in the entire Texas State Park system. The presence of these protected public lands contributes greatly to the quality of life for area residents in a way that is not easily described in gallons, acre-feet or dollars and cents. It has been amply demonstrated that to attract 21st century enterprise that pays top salaries for skilled workers, quality of life is a critical issue. The spectacular natural and cultural heritage of the Region not only attracts many hundreds of thousands of temporary visitors per year to Far West Texas (more than 650,000 per year just to Guadalupe Mountains and Big Bend National Parks), it also helps to attract new residents and businesses to the Region. Providing sufficient water for recreation and habitat in Far West Texas is critical to long-term economic health.

All living organisms require water. The amount and quality of water required to maintain a viable population, whether it be 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. In both cases, endemic wildlife to this desert region of Texas has adapted to the harsh climatic conditions.

Because most available water-supply sources in Far West Texas are relatively small in areal extent and are generally separated by great distances, wildlife dependent on isolated sources exist at the mercy of that water supply. The loss of the supply source, even for a short time, may result in the loss or degradation of the resident species.

Quantifying minimum flows at upland water sources that support wildlife and game through the year is difficult in terms of gallons and acre-feet; however, it is an observable fact that wildlife populations flux wildly over the years due to relative abundance or scarcity of rainfall and related spring productivity. It has also been observed that even major springs that historically have never run dry can disappear when local aquifers are pumped beyond sustainable levels. Even minor aquifer depletion can have a profound effect on wildlife habitat and recreational opportunities in affected local areas.

Quantifying environmental and recreational water needs in some cases has been achieved. For the Rio Grande below Presidio, measured at the IBWC gage below Alamito Creek, a flow of 250 cubic feet per second is sufficient to support minimum needs. When flows fall below this point for any length of time, recreational, agricultural, and habitat values are seriously degraded.

Recreation includes those activities that involve human interaction with the outdoors environment. Many of these activities are directly dependent on water resources such as fishing, swimming, and boating; while a healthy environment enhances many others, such as 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 Far West Texas as well as the thousands of annual visitors to this Region.

In terms of the regional planning process, discussion of environmental and recreational water needs has been largely considered a rural issue, and generally overlooked because of the perceived priority of other issues. However, every regional resident uses environmental and recreational water, be it for personal lawn and garden, a golf course, a swimming pool, or for canoeing the Rio Grande, hunting deer, or watching birds. In urban areas and small towns, environmental and recreational needs can constitute a third or more of total use during hot months. The FWTWPG recognizes the importance of supplying adequate environmental and recreational water fairly to all users, and supports the goal of better quantifying those needs in future planning cycle.

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 the *2016 Far West Texas Water 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.

In Chapter 5, each water management strategy contains an environmental impact assessment. A review of this chapter 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 springs to cease flowing. Also of concern is that lowered water levels could deplete supplies in shallow livestock wells that 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.

This page intentionally left blank.

CHAPTER 3

REGIONAL WATER SUPPLY SOURCES

This page intentionally left blank.

3 REGIONAL WATER SUPPLY SOURCES

Whether it flows in rivers or percolates through underground rock formations, water sustains life and thus is our most important natural resource. In the Chihuahuan Desert environment of Far West Texas, water supply availability takes on a more significant meaning than elsewhere in the State. With evaporation far exceeding rainfall, planning for the most efficient management of limited water supplies is essential.

Chapter 3 explores the current and future availability of all water supply resources in the Region including surface water, groundwater and reuse, all of which is contained within the Rio Grande river basin. 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 Far West Texas that potentially could experience supply shortages in future years. Water supply availability from each recognized source is estimated during *drought-of record* conditions, which allows each entity and water-use category to observe conditions when their supply source is at its most critical availability level.

- With the exception of the controlled flows in the Rio Grande, very little surface water can be considered as a reliable source of supply in Far West Texas, especially in drought-of-record conditions. In this chapter, two primary surface water sources are considered, the Rio Grande and the Pecos River. Other ephemeral creeks and springs are recognized as important livestock supply, wildlife habitat, and recreational resources. The availability of water in the Rio Grande and Pecos River (Run-of-River) to meet existing permits is determined by using the TCEQ Rio Grande Water Availability Model (WAM) – Run 3. Municipal Run-of-River calculations utilize the unmodified TCEQ WAM Run 3 to insure that all monthly demands are fully met. All surface water rights are listed in Appendix 3A.
- The availability of groundwater is based on TWDB provided Modeled Available Groundwater (MAG) as developed through the Groundwater Management Area process. For aquifers that MAG volumes have not been assigned, groundwater availability is calculated separately.
- Reuse of water is calculated for the City of El Paso based on anticipated build-out of their "purple pipe" project and advanced purified water treatment projects.
- No groundwater availability requirements or limitations as might have been promulgated by the El Paso County Commissioner's Court are associated with the El Paso County Priority Groundwater Management Area. El Paso Water Utilities continues to assume the role as the designated "Regional Water Supply Planner" (see Chapter 1, Section 1.1.6).
- Water supplies based upon contracts are assumed to be renewed if they expire during the planning horizon.

Water supplies available to meet recognized demands are reported in Tables 3-1 and 3-2. Table 3-1indicates the maximum amount of water supply that could be obtained from each unique supply source, while Tables 3-2 and 3-3 lists water supplies that are available to cities, water-user categories, and wholesale water providers based on their current ability to obtain water from existing sources. Current infrastructure, legal limitations, and the physical availability of water from each source determine this availability. The amounts listed for cities and the "county other" category (representing small communities and rural households) are based on TCEQ estimates of infrastructure capabilities.

Table 3-1. Water Supply Source Availability (Rio Grande River Basin)
(Acre Feet per Year)

Groundwater	County	Salinity	2020	2030	2040	2050	2060	2070
Bone Spring-Victorio Peak Aquifer	Hudspeth	Fresh/Brackish	101,429	101,429	101,429	101,429	101,429	101,429
Capitan Reef Complex Aquifer	Brewster	Fresh/Brackish	2,100	2,100	2,100	2,100	2,100	2,100
Capitan Reef Complex Aquifer	Culberson	Fresh/Brackish	7,580	7,580	7,580	7,580	7,580	7,580
Capitan Reef Complex Aquifer | Non-Relevant	Hudspeth	Fresh/Brackish	5,100	5,100	5,100	5,100	5,100	5,100
Edwards Trinity-Plateau Aquifer	Culberson	Fresh	2,154	2,154	2,154	2,154	2,154	2,154
Edwards Trinity-Plateau Aquifer | Non-Relevant	Jeff Davis	Fresh	9,288	9,288	9,288	9,288	9,288	9,288
Edwards Trinity-Plateau Aquifer	Brewster	Fresh/Brackish	1,394	1,394	1,394	1,394	1,394	1,394
Edwards Trinity-Plateau Aquifer	Terrell	Fresh	1,421	1,421	1,421	1,421	1,421	1,421
Hueco-Mesilla Bolson Aquifer	El Paso	Fresh/Brackish	480,000	480,000	480,000	480,000	480,000	480,000
Hueco-Mesilla Bolson Aquifer	Hudspeth	Fresh/Brackish	16,000	16,000	16,000	16,000	16,000	16,000
Igneous Aquifer	Brewster	Fresh	2,586	2,586	2,585	2,583	2,581	2,581
Igneous Aquifer	Culberson	Fresh	99	99	99	99	99	99
Igneous Aquifer	Jeff Davis	Fresh	4,584	4,584	4,584	4,584	4,584	4,584
Igneous Aquifer	Presidio	Fresh	4,064	4,064	4,064	4,063	4,063	4,063
Marathon Aquifer	Brewster	Fresh	7,327	7,327	7,327	7,327	7,327	7,327
Other Aquifer | Brewster Cretaceous	Brewster	Fresh	2,800	2,800	2,800	2,800	2,800	2,800
Other Aquifer | Diablo Plateau	Hudspeth	Fresh	26,400	26,400	26,400	26,400	26,400	26,400
Other Aquifer | Balmorhea Alluvium	Jeff Davis	Fresh	500	500	500	500	500	500
Other Aquifer | Presidio Cretaceous	Presidio	Fresh	1,000	1,000	1,000	1,000	1,000	1,000
Other Aquifer | Rio Grande Alluvium	El Paso	Brackish	130,380	130,380	130,380	130,380	130,380	130,380
Other Aquifer | Rio Grande Alluvium	Hudspeth	Brackish	15,000	15,000	15,000	15,000	15,000	15,000
Rustler Aquifer	Brewster	Brackish/Saline	0	0	0	0	0	0
Rustler Aquifer	Culberson	Brackish/Saline	1,000	1,000	1,000	1,000	1,000	1,000
West Texas Bolsons Aquifer | Salt Basin	Culberson	Fresh/Brackish	35,749	35,678	35,601	35,550	35,509	35,509
West Texas Bolsons Aquifer | Salt Basin	Jeff Davis	Fresh	6,055	6,055	5,989	5,960	5,942	5,942
West Texas Bolsons Aquifer | Salt Basin	Presidio	Fresh	9,112	8,982	8,834	8,710	8,640	8,640
West Texas Bolsons Aquifer | Eagle Flat	Hudspeth	Fresh/Brackish	2,869	2,869	2,869	2,869	2,869	2,869
West Texas Bolsons Aquifer | Green River Valley	Hudspeth	Fresh/Brackish	82	82	82	82	82	82
West Texas Bolsons Aquifer | Green River Valley	Jeff Davis	Fresh/Brackish	82	82	82	82	82	82

Table 3-1. (Continued) Water Supply Source Availability (Rio Grande River Basin)
(Acre Feet per Year)

Groundwater	County	Salinity	2020	2030	2040	2050	2060	2070
West Texas Bolsons Aquifer | Green River Valley	Presidio	Fresh/Brackish	82	82	82	82	82	82
West Texas Bolsons Aquifer | Presidio-Redford	Presidio	Fresh/Brackish	6,282	6,282	6,282	6,282	6,282	6,282
West Texas Bolsons Aquifer | Red Light Draw	Hudspeth	Fresh/Brackish	1,631	1,631	1,631	1,631	1,631	1,631
West Texas Bolsons Aquifer | Upper Salt Basin	Hudspeth	Brackish	250	250	250	250	250	250
West Texas Bolsons Aquifer | Upper Salt Basin	Culberson	Brackish	16,851	16,851	16,851	16,851	16,851	16,851
Groundwater Total Source Availability			**901,251**	**901,050**	**900,758**	**900,551**	**900,420**	**900,420**
Reuse	**County**	**Salinity**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Direct Reuse	El Paso	Fresh	6,000	6,000	6,000	6,000	6,000	6,000
Indirect Reuse	El Paso	Fresh	31,002	32,939	34,799	36,922	39,105	41,102
Indirect Reuse	Hudspeth	Fresh	334	334	334	334	334	334
Reuse Total Source Availability			**37,336**	**39,273**	**41,133**	**43,256**	**45,439**	**47,436**
Surface Water	**County**	**Salinity**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Rio Grande Livestock Local Supply	Brewster	Fresh	19	19	19	19	19	19
Rio Grande Livestock Local Supply	Culberson	Fresh	15	15	15	15	15	15
Rio Grande Livestock Local Supply	El Paso	Fresh	26	26	26	26	26	26
Rio Grande Livestock Local Supply	Hudspeth	Fresh	81	81	81	81	81	81
Rio Grande Livestock Local Supply	Jeff Davis	Fresh	25	25	25	25	25	25
Rio Grande Livestock Local Supply	Presidio	Fresh	41	41	41	41	41	41
Rio Grande Other Local Supply	Brewster	Fresh	0	0	0	0	0	0
Rio Grande Other Local Supply	Culberson	Fresh	78	78	78	78	78	78
Rio Grande Other Local Supply	El Paso	Fresh	3,026	3,026	3,026	3,026	3,026	3,026
Rio Grande Other Local Supply	Hudspeth	Fresh	240	240	240	240	240	240
Rio Grande Other Local Supply	Jeff Davis	Fresh	50	50	50	50	50	50
Rio Grande Other Local Supply	Presidio	Fresh	0	0	0	0	0	0
Rio Grande Other Local Supply	Terrell	Fresh	40	40	40	40	40	40

Table 3-1. (Continued) Water Supply Source Availability (Rio Grande River Basin)
(Acre Feet per Year)

Surface Water	County	Salinity	2020	2030	2040	2050	2060	2070
Rio Grande Run-of-River	Brewster	Fresh	8,082	8,082	8,082	8,082	8,082	8,082
Rio Grande Run-of-River	El Paso	Fresh	66,631	66,631	66,631	66,631	66,631	66,631
Rio Grande Run-of-River	Hudspeth	Fresh	1,150	1,150	1,150	1,150	1,150	1,150
Rio Grande Run-of-River	Presidio	Fresh	10,853	10,853	10,853	10,853	10,853	10,853
Rio Grande Run-of-River	Terrell	Fresh	676	676	676	676	676	676
Surface Water Total Source Availability			**91,037**	**91,037**	**91,037**	**91,037**	**91,037**	**91,037**
Region E Total Source Availability			**1,029,624**	**1,031,360**	**1,032,928**	**1,034,844**	**1,036,896**	**1,038,893**

Note: Largest amount of water that can be withdrawn from a given source without violating the most restrictive physical, regulatory, or policy conditions limiting withdrawals, under drought-of-record conditions. All sources are within the Rio Grande Basin.

Table 3-2. Water User Group Water Supply Capacity (Rio Grande River Basin)
(Acre Feet per Year)

Brewster County		**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Alpine	Igneous Aquifer	1,428	1,428	1,428	1,428	1,428	1,428
Alpine	Igneous Aquifer | Jeff Davis	738	738	738	738	738	738
County-Other	Edwards-Trinity Plateau Aquifer	28	28	28	28	28	28
County-Other	Igneous Aquifer	554	554	554	554	554	554
County-Other	Marathon Aquifer	96	96	96	96	96	96
County-Other	Other Aquifer	388	388	388	388	388	388
Manufacturing	Igneous Aquifer	4	4	4	4	4	4
Livestock	Capitan Reef Complex	112	112	112	112	112	112
Livestock	Edwards-Trinity Plateau Aquifer	112	112	112	112	112	112
Livestock	Igneous Aquifer	112	112	112	112	112	112
Livestock	Marathon Aquifer	31	31	31	31	31	31
Livestock	Rio Grande Livestock Local Supply	19	19	19	19	19	19
Irrigation	Igneous Aquifer	291	291	291	291	291	291
Irrigation	Other Aquifer	2,381	2,381	2,381	2,381	2,381	2,381
Irrigation	Rio Grande Run-Of-River	600	600	600	600	600	600
Brewster County Total Existing Supply		6,894	6,894	6,894	6,894	6,894	6,894
Culberson County		**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Van Horn	West Texas Bolsons Aquifer	1,351	1,351	1,351	1,351	1,351	1,351
County-Other	Edwards-Trinity Plateau Aquifer	3	3	3	3	3	3
County-Other	Rustler Aquifer	1	1	1	1	1	1
County-Other	West Texas Bolsons Aquifer	136	136	136	136	136	136
Mining	Rio Grande Other Local Supply	78	78	78	78	78	78
Mining	Rustler Aquifer	47	47	47	47	47	47
Mining	West Texas Bolsons Aquifer	90	90	90	90	90	90
Livestock	Edwards-Trinity Plateau	29	29	29	29	29	29
Livestock	Rio Grande Livestock Local Supply	15	15	15	15	15	15
Livestock	Rustler Aquifer	28	28	28	28	28	28
Livestock	West Texas Bolsons Aquifer	228	228	228	228	228	228
Irrigation	Capitan Reef Complex	7,563	7,563	7,563	7,563	7,563	7,563
Irrigation	West Texas Bolsons Aquifer	32,422	32,422	32,422	32,422	32,422	32,422
Culberson County Total Existing Supply		41,991	41,991	41,991	41,991	41,991	41,991
El Paso County		**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Anthony	Hueco-Mesilla Bolson Aquifer	1,202	1,202	1,202	1,202	1,202	1,202
Clint	Hueco-Mesilla Bolson Aquifer	276	276	276	276	276	276
El Paso	Direct Reuse	6,000	6,000	6,000	6,000	6,000	6,000

Table 3-2 (Continued). Water User Group Water Supply Capacity (Rio Grande River Basin)
(Acre Feet per Year)

El Paso County (Continued)		**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
El Paso	Hueco-Mesilla Bolson Aquifer	115,000	115,000	115,000	115,000	115,000	115,000
El Paso	Rio Grande Run-Of-River	10,000	10,000	10,000	10,000	10,000	10,000
El Paso County Tornillo WID	Hueco-Mesilla Bolson Aquifer	484	484	484	484	484	484
El Paso WCID #4	Hueco-Mesilla Bolson Aquifer	1,065	1,065	1,065	1,065	1,065	1,065
Fort Bliss	Hueco-Mesilla Bolson Aquifer	1,622	1,622	1,622	1,622	1,622	1,622
Fort Bliss	Rio Grande Run-Of-River	0	0	0	0	0	0
Horizon City	Hueco-Mesilla Bolson Aquifer	2,222	2,222	2,222	2,222	2,222	2,222
Horizon City	Rio Grande River Alluvium Aquifer Brackish	884	884	884	884	884	884
Horizon Regional MUD	Hueco-Mesilla Bolson Aquifer	1,746	1,746	1,746	1,746	1,746	1,746
Horizon Regional MUD	Rio Grande River Alluvium Aquifer Brackish	694	694	694	694	694	694
Lower Valley WD	Hueco-Mesilla Bolson Aquifer	1,121	1,121	1,121	1,121	1,121	1,121
Socorro	Hueco-Mesilla Bolson Aquifer	2,959	2,959	2,959	2,959	2,959	2,959
Vinton	Hueco-Mesilla Bolson Aquifer	400	400	400	400	400	400
County-Other	Hueco-Mesilla Bolson Aquifer	6,278	6,278	6,278	6,278	6,278	6,278
Manufacturing	Hueco-Mesilla Bolson Aquifer	7,297	7,297	7,297	7,297	7,297	7,297
Mining	Hueco-Mesilla Bolson Aquifer	680	680	680	680	680	680
Mining	Rio Grande Other Local Supply	3,026	3,026	3,026	3,026	3,026	3,026
Mining	Rio Grande River Alluvium Aquifer Brackish	2,000	2,000	2,000	2,000	2,000	2,000
Steam Electric Power	Hueco-Mesilla Bolson Aquifer	3,286	3,286	3,286	3,286	3,286	3,286
Livestock	Hueco-Mesilla Bolson Aquifer	603	603	603	603	603	603
Livestock	Rio Grande Livestock Local Supply	26	26	26	26	26	26
Irrigation	Rio Grande Indirect Reuse	31,002	32,939	34,799	36,922	37,697	37,697
Irrigation	Rio Grande River Alluvium Aquifer Brackish	80,000	80,000	80,000	80,000	80,000	80,000
Irrigation	Rio Grande Run-Of-River	56,631	56,631	56,631	56,631	56,631	56,631
El Paso County Total Existing Supply		336,504	338,441	340,301	342,424	343,199	343,199
Hudspeth County		**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Sierra Blanca	West Texas Bolsons Aquifer | Culberson	842	842	842	842	842	842
County-Other	Bone Spring Victorio-Peak Aquifer	63	63	63	63	63	63
County-Other	Hueco-Mesilla Bolson Aquifer	122	122	122	122	122	122
County-Other	Rio Grande River Alluvium Aquifer Brackish	731	731	731	731	731	731
Manufacturing	Rio Grande River Alluvium Aquifer Brackish	10	10	10	10	10	10
Mining	Rio Grande Other Local Supply	240	240	240	240	240	240
Mining	Rio Grande River Alluvium Aquifer Brackish	21	21	21	21	21	21
Mining	West Texas Bolsons Aquifer	220	220	220	220	220	220
Livestock	Bone Spring Victorio-Peak Aquifer	23	23	23	23	23	23
Livestock	Capitan Reef Complex Aquifer	10	10	10	10	10	10

Table 3-2. (Continued) Water User Group Water Supply Capacity (Rio Grande River Basin)
(Acre Feet per Year)

Hudspeth County - Rio Grande Basin (Continued)		**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Livestock	Hueco-Mesilla Bolson Aquifer	64	64	64	64	64	64
Livestock	Other Aquifer	322	322	322	322	322	322
Livestock	Rio Grande Livestock Local Supply	81	81	81	81	81	81
Livestock	West Texas Bolsons Aquifer	41	41	41	41	41	41
Irrigation	Bone Spring Victorio-Peak Aquifer	63,843	63,843	63,843	63,843	63,843	63,843
Irrigation	Capitan Reef Complex Aquifer	5,000	5,000	5,000	5,000	5,000	5,000
Irrigation	Rio Grande Indirect Reuse	334	334	334	334	334	334
Irrigation	Rio Grande River Alluvium Aquifer Brackish	14,000	14,000	14,000	14,000	14,000	14,000
Irrigation	Rio Grande Run-Of-River	816	816	816	816	816	816
Hudspeth County Total Existing Supply		86,783	86,783	86,783	86,783	86,783	86,783
Jeff Davis County		**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Fort Davis	Igneous Aquifer	343	343	343	343	343	343
County-Other	Edwards-Trinity Plateau Aquifer	10	10	10	10	10	10
County-Other	Igneous Aquifer	428	428	428	428	428	428
County-Other	Rio Grande River Alluvium Aquifer	196	196	196	196	196	196
County-Other	West Texas Bolsons Aquifer	38	38	38	38	38	38
Livestock	Edwards-Trinity Plateau Aquifer	117	117	117	117	117	117
Livestock	Igneous Aquifer	70	70	70	70	70	70
Livestock	Rio Grande Livestock Local Supply	25	25	25	25	25	25
Livestock	Rio Grande River Alluvium Aquifer	212	212	212	212	212	212
Livestock	West Texas Bolsons Aquifer	71	71	71	71	71	71
Irrigation	Igneous Aquifer	735	735	735	735	735	735
Irrigation	Rio Grande Other Local Supply	50	50	50	50	50	50
Irrigation	West Texas Bolsons Aquifer	2,572	2,572	2,572	2,572	2,572	2,572
Jeff Davis County Total Existing Supply		4,867	4,867	4,867	4,867	4,867	4,867
Presidio County		**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Marfa	Igneous Aquifer	1,774	1,774	1,774	1,774	1,774	1,774
Presidio	West Texas Bolsons Aquifer	3,589	3,589	3,589	3,589	3,589	3,589
County-Other	Igneous Aquifer	353	353	353	353	353	353
County-Other	Other Aquifer	223	223	223	223	223	223
County-Other	West Texas Bolsons Aquifer	12	12	12	12	12	12
Mining	Other Aquifer	403	403	403	403	403	403
Livestock	Igneous Aquifer	81	81	81	81	81	81
Livestock	Other Aquifer	143	143	143	143	143	143

Table 3-2. (Continued) Water User Group Water Supply Capacity (Rio Grande River Basin)
(Acre Feet per Year)

Presidio County (Continued)		**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Livestock	Rio Grande Livestock Local Supply	41	41	41	41	41	41
Livestock	West Texas Bolsons Aquifer	143	143	143	143	143	143
Irrigation	Igneous Aquifer	400	400	400	400	400	400
Irrigation	Rio Grande Run-Of-River	6,140	6,140	6,140	6,140	6,140	6,140
Irrigation	West Texas Bolsons Aquifer	2,461	2,461	2,461	2,461	2,461	2,461
Presidio County Total Existing Supply		15,763	15,763	15,763	15,763	15,763	15,763
Terrell County		**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Sanderson	Edwards-Trinity Plateau Aquifer	527	527	527	527	527	527
County-Other	Edwards-Trinity Plateau Aquifer	61	61	61	61	61	61
Mining	Edwards-Trinity Plateau Aquifer	184	184	184	184	184	184
Mining	Rio Grande Other Local Supply	40	40	40	40	40	40
Livestock	Edwards-Trinity Plateau Aquifer	234	234	234	234	234	234
Livestock	Rio Grande Livestock Local Supply	4	4	4	4	4	4
Irrigation	Edwards-Trinity Plateau Aquifer	415	415	415	415	415	415
Irrigation	Rio Grande Run-Of-River	676	676	676	676	676	676
Terrell County Total Existing Supply		2,141	2,141	2,141	2,141	2,141	2,141
Region E Total Existing Supply		**494,943**	**496,880**	**498,740**	**500,863**	**501,638**	**501,638**

Note: Water Supply capacity based on current infrastructure, existing contracts, and source supply availability under drought-of-record conditions. All WUGs and supplies are within the Rio Grande Basin.

Table 3-3. Far West Texas Wholesale Water Provider Supplies (Rio Grande River Basin)
(Acre-Feet per Year)

Wholesale Water Provider	Source Supply	Water Demand (Acre-Feet/Year)					
		2020	2030	2040	2050	2060	2070
El Paso County WID#1	Rio Grande Indirect Reuse	31,002	32,939	34,799	36,922	37,697	37,697
	Rio Grande Alluvium Aquifer	80,000	80,000	80,000	80,000	80,000	80,000
	Rio Grande Run-Of-River	56,631	56,631	56,631	56,631	56,631	56,631
	Total Supply	**167,633**	**169,570**	**171,430**	**173,553**	**174,328**	**174,328**
El Paso Water Utilities	Direct Reuse	6,000	6,000	6,000	6,000	6,000	6,000
	Hueco-Mesilla Bolson Aquifer	115,000	115,000	115,000	115,000	115,000	115,000
	Rio Grande Run-Of-River	10,000	10,000	10,000	10,000	10,000	10,000
	Total Supply	**131,000**	**131,000**	**131,000**	**131,000**	**131,000**	**131,000**
Lower Valley Water District	Hueco-Mesilla Bolson Aquifer	4,356	4,356	4,356	4,356	4,356	4,356
	Total Supply	**4,356**	**4,356**	**4,356**	**4,356**	**4,356**	**4,356**
Horizon Regional MUD	Hueco-Mesilla Bolson Aquifer	3,968	3,968	3,968	3,968	3,968	3,968
	Rio Grande Alluvium Aquifer	1,578	1,578	1,578	1,578	1,578	1,578
	Total Supply	**5,546**	**5,546**	**5,546**	**5,546**	**5,546**	**5,546**

3.1 RIO GRANDE

Waters of the Rio Grande (Mexico's Rio Bravo) originate in the San Luis Valley, the principal drainage basin of the San Juan Mountains in southwestern Colorado, and in the mountain ranges of northern New Mexico. The river flows southward through New Mexico, and then forms the international boundary between the Mexican States of Chihuahua, Coahuila, Nuevo Leon, Tamaulipas, and the State of Texas. The Rio Grande's total length is approximately 1,896 miles, with approximately 1,248 making the international boundary between Texas and Mexico. Figure 3-1 illustrates the sub-drainage basins of the Rio Grande Basin.

The water supply available from the Upper Rio Grande is affected by climatic conditions in Colorado and northern New Mexico. Although dams have been built on the River in New Mexico to provide a degree of control, floods and droughts still take their toll in the region. Most of the Rio Grande's flow above Fort Quitman is diverted at the Mesilla Dam in New Mexico to support irrigation in Dona Ana County, New Mexico and at the American Dam in Texas to supply irrigation and municipal demand in Texas. Water is also diverted at the International Dam for delivery through the Acequia Madre to supply irrigation demand in Mexico as stipulated by Treaty. Downstream from El Paso, most of the flow in the River consists of irrigation return flow, and small amounts of treated and larger amounts of untreated municipal wastewater.

The flow from below Fort Quitman to Presidio is often intermittent and is referred to as the "Forgotten River". The River becomes a permanent stream again at the point where the Mexican river, the Rio Conchos, enters upstream of Presidio. From Presidio downstream through the Big Bend until it reaches the Amistad Reservoir, the Rio Grande often lacks sufficient flow to adequately support minimum recreational, environmental, or agricultural needs; and during dry periods, may fall significantly short of supplying such needs.

Under drought conditions in the upper catchment basin, flows in the Rio Grande are significantly reduced and are allotted by the United States Bureau of Reclamation (USBR) in accordance with a prearranged schedule. Low releases and diversions significantly affect downstream water users who are highly dependent on a steady source of river water. In addition, such low diversions result in a degradation of the River's water and environmental quality.

American Heritage River Initiative – The Rio Grande, from El Paso to Laredo, is one of only 14 rivers in the United States, and the only river in Texas, to receive the American Heritage River designation. Established in 1997, the American Heritage River Initiative recognizes rivers, or segments of rivers, that have played a significant role in the history and culture of the region it traverses. The initiative gives federal support to voluntary community-led work that benefits riverfront communities. Some of the possible benefits of being designated an American Heritage River are increased opportunities in commerce and trade, recreational improvements along the River, incorporation of wildlife habitats, and cultural stimulation. The American Heritage River Initiative does not conflict with matters of state and local government jurisdiction, such as water rights, land-use planning and water-quality standards. Also, the initiative does not impair the authority of each state to allocate quantities of water within its jurisdiction.

Rio Grande Wild and Scenic River – In 1978, Congress designated a 196-mile reach of the Rio Grande, from the Coahuila-Chihuahua State line, near Mariscal Canyon, to the Terrell-Val Verde County line, a "Wild and Scenic River". This segment of the River is recommended by the Far West Texas Water Planning Group (FWTWPG) as an "Ecologically Unique River Segment" and is discussed in further detail in Chapter 8.

3.1.1 Rio Grande Treaties and Compact

Water demand related to irrigation use and population growth has affected the Rio Grande since the 1800s. Water appropriations and shortages have spawned lawsuits, as well as the involvement of the federal government in the management of the River. The following sections describe efforts by state and national governments to address many of the complex issues associated with the Rio Grande.

1906 International Treaty – Under the 1906 International Treaty, the United States is obligated to deliver 60,000 acre-feet of water annually from the Rio Grande to Mexico, except in case of extraordinary drought or serious accident to the irrigation system in the United States. The 60,000 acre-feet must be delivered, at no cost to Mexico and in accordance with a monthly distribution schedule from February through November, in the bed of the Rio Grande at the headworks of the Acequia Madre (International Dam). The International Boundary and Water Commission (IBWC)/Comisión International de Límites y Aguas (CILA) is the designated binational agency that makes the yearly delivery of international waters to Mexico. The U.S. Bureau of Reclamation (USBR) calculates the allocations in coordination with the IBWC.

Rio Grande Compact – The Rio Grande Compact is a tri-state agreement, approved by the U.S. Congress and ratified by the states of Colorado, New Mexico and Texas. The Rio Grande Compact Commission, which administers the Compact, is comprised of a Commissioner from each of the states and a nonvoting chairman appointed by the President of the United States. The Compact encompasses the waters of the Rio Grande from the southern Colorado headwaters to above Fort Quitman, Texas and distributes them between the three states. It sets out a schedule of the water-delivery obligation of Colorado at the Colorado/New Mexico state line and the obligation of New Mexico to deliver water to Texas via Rio Grande Project reservoirs at Elephant Butte and Caballo. Releases from the reservoirs are measured downstream of Caballo Reservoir.

1944 International Treaty – The 1944 International Treaty addresses the waters in the international segment of the Rio Grande from Fort Quitman, Texas to the Gulf of Mexico. The Treaty allocates water in the River based on percentage of flows in the River from each country's tributaries to the Rio Grande. The 1944 Treaty also stipulates that one-third of the flow of the Rio Conchos in Mexico is allotted to the United States. The Rio Conchos is by far the largest tributary of the Rio Grande. The treaty requires that the combined flow of the Rio Conchos and five other tributaries (San Diego, San Rodrigo, Escondido, Salado Rivers and Las Vacas Arroyo) shall have an annual average of not less than 350,000 acre-feet. The IBWC/CILA is responsible for implementing the treaties between the United States and Mexico. In recent years, the required minimum flow has not been met.

3.1.2 Rio Grande Project

The Rio Grande Project is an irrigation storage and flood control federal reclamation project administered by the USBR. Elephant Butte and Caballo Reservoirs in New Mexico and the diversion dams at the headings of the main canals make up the Project's primary facilities. The Project delivers water to the Elephant Butte Irrigation District (EBID) and the El Paso County Water Improvement District No. 1 (EPCWID#1). The EBID encompasses all the project lands in New Mexico south of the Caballo Reservoir deliver water to farmlands in New Mexico. The Project also delivers water to Mexico in accordance with the Treaty of 1906. In 1979 and 1980, the two Districts took over the operation and maintenance responsibilities of most of the respective irrigation works within the boundaries of each entity. Legal titles to the rights-of-way of irrigation canals and drains were transferred from the United States to the Districts in January 1996.

El Paso County Water Improvement District No. 1 – In Texas, the Rio Grande Project provides water for 69,010 acres of water right lands, all of which are located within the boundaries of the EPCWID #1. The District contains 156 square miles, with over 350 miles of canals and laterals in the distribution system, and over 269 miles in the drainage system. Water is delivered through canals and laterals to more than 2,205 turnouts, irrigating crops of cotton, alfalfa, pecans, chilies, wheat, milo, vegetables, pastures and family gardens. Since 1941, EPCWID#1 has delivered water to the City of El Paso for municipal and industrial use through contracts among the District, the City and the USBR. The City of El Paso also owns farmland with first class water rights, which it uses for municipal purposes.

Project Water Allocation – Deliveries of Rio Grande Project water is based on irrigation requirements authorized for the Project and are agreed on by the two irrigation districts and the USBR. The annual allotment of Rio Grande Project water downstream of the Caballo Reservoir is determined by the USBR based on the amount of usable water in storage. Through data obtained from the measurement of snow pack and river gauging stations along the upper reaches of the Rio Grande, the USBR determines the projected inflow to Elephant Butte Reservoir. The USBR measures storage available in the Elephant Butte and Caballo Reservoirs and projects volumes available for allocation as a 30-year moving average.

Total releases from Project storage during a full-allotment year average approximately 764,000 acre-feet. Total diversions, however, average approximately 932,000 acre-feet per year. Total average diversions exceed average total releases by 168,000 acre-feet. The difference between the two is attributable to irrigation and municipal return flows, operations spills from upstream users, and rainfall runoff. Total diversion allocations are 495,000 acre-feet to EBID, 376,000 acre-feet to EPCWID#1, and 60,000 acre-feet to Mexico during years of full supply.

Currently, the City of El Paso's right to use water from the Project arises from its ownership of 2,000 acres of land with rights to use water, approximately 5,542 acres of 50- and 75-year term City of El Paso Irrigation Water Assignments (Leases) for rights to use water from urbanized land parcels, and approximately 3,088 acres of Lower Valley Water District (LVWD) leases. The rights to use water from the LVWD leases are transferred to the City of El Paso on an annual basis in exchange for a wholesale supply of water from the City. EPWU receives an annual allocation for water leased and land ownership categories based on the yearly allocation and the provisions of the respective 1941, 1962, 1989, and 2001 contracts. During a full allocation year, EPWU has rights to divert 65,000 acre-feet of Rio Grande Project water from all contract sources. The conversion of rights to use water from agricultural to municipal and industrial use must be contracted with the EPCWID#1 and the USBR. El Paso has also finalized an agreement with EPCWID#1 to acquire additional raw water based on EPCWID#1's operation of new shallow wells intended for drought relief. The 2001 Third Party Implementing Contract with EPCWID#1 converts to municipal and industrial use Project water saved from canal lining, operational efficiencies, and other miscellaneous water sources. The City has negotiated and agreed in principal on the terms of a

Third Party Implementing Contract that would allow it to contract for the conversion of rights to use water directly from farmers through the use of short-term "Forbearance Contracts."

3.1.3 Hudspeth County Conservation and Reclamation District No. 1

The HCCRD #1 was created in 1924 to provide irrigation waters to 18,300 acres of Rio Grande bottomlands that are located downstream of the El Paso-Hudspeth County line to Fort Quitman. The District operates under a Warren Act contract and diverts tailwater, returns and excess flows from the Rio Grande Project. Water reuse and recycling are its primary operations; the District does not provide potable water. Headquarters are located in Fort Hancock.

Water sources include untreated water from permitted Rio Grande diversions, drainage waters, return flows from farming operations, operational waste associated with the U.S. Bureau of Reclamation's Rio Grande Project, and return flows from El Paso water and sewage treatment plants. The supply to the District is completely dependent on the EPCWID #1, and therefore can be unpredictable. When flows are erratic, the District utilizes drought contingency planning. If a mild to moderate shortage is predicted, users are notified of the expected shortage. For severe shortages, when supply is less than half of demand, agricultural producers are asked to prioritize water requests based upon crop needs.

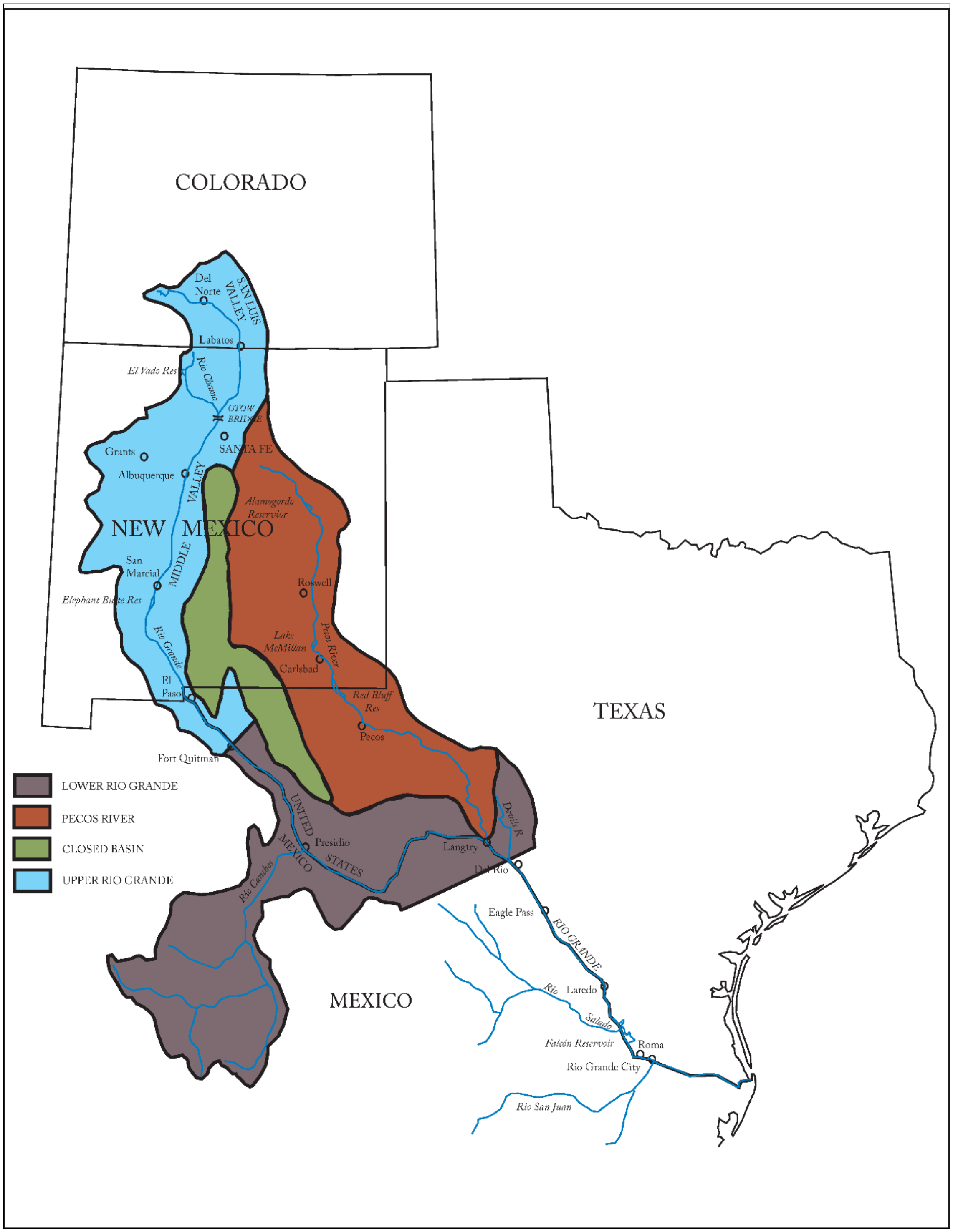


Figure 3-1. Far West Texas Drainage Basins
(USGS Professional Paper 372-D)

3.1.4 Rio Grande Watermaster

A binational commission determines the allocation of Rio Grande water below Ft. Quitman and the TCEQ Rio Grande Watermaster administers the allocation of Texas' share of international waters. Two reservoirs located in the middle of the Lower Rio Grande, Amistad and Falcon, store the water allocated by the Watermaster. The Watermaster oversees Texas' share of water in the Lower Rio Grande and its Texas tributaries from Fort Quitman to Amistad Dam, excluding the drainage basins of the Pecos and Devils Rivers.

3.1.5 Rio Grande Water Quality

The quality of water in the segment of the Rio Grande that flows through Far West Texas varies significantly from specific location and season of the year. Of prime consideration is that there is little natural flow in the River. The TNRCC's (predecessor name of TCEQ) inventory of water quality in the state (TNRCC, 1996) cites drainage area and a wide range of geologic and climatic conditions in Far West Texas as factors responsible for water-quality conditions in the Rio Grande. Heavy metals and pesticides have been identified along the course of the Rio Grande. Elevated fecal coliform and nutrient levels occur in the River downstream of border cities, primarily because of untreated wastewater from Mexico. Additional discussion on Rio Grande water quality is provided in Chapter 1, Section 1.8.

3.1.6 Long-Term Reliability of the Rio Grande

The long-term reliability of Rio Grande water is sporadic. Aside from the legal mechanisms governing allocation of the water from Elephant Butte Reservoir and the allocation of water between the two nations of Mexico and the United States, the meteorologic and hydrologic reality is that the El Paso area is supplied by the Rio Grande, which has its headwaters in a climatic regime totally apart from the climatic regime of Far West Texas. If a drought occurs in Colorado, then the El Paso area is essentially thrown into a drought-like scenario. Drought prediction modeling, although attempted by climatologists worldwide, is still in its infancy and therefore the likelihood of a sure knowledge of long-term availability of water in the Rio Grande headwaters is slim.

3.1.7 Rio Grande Channelization

In 1933, the United States and Mexico signed a Convention entitled, "Rectification of the Rio Grande", in which the two countries agreed to provide flood protection to urban, suburban and agricultural lands and stabilize the international boundary line. Construction work authorized by this Convention addressed channel aggrading due to the flat gradient and low velocities of the Rio Grande and the new channels that tended to form on lower ground during flood flows. The rectified channel between its upper end at Cordova Island, near El Paso, to its lower end reduced the original river channel length from 155.2 miles to 85.6 miles and increased the gradient from about two feet per mile to 3.2 feet per mile. The Rectification Project also included the construction of three toll-free bridges. Construction commenced in March 1934 and was completed in 1938. In June of 1987, Riverside Dam failed. The EPCWID#1 constructed a temporary rock cofferdam immediately downstream of Riverside Dam as a temporary means of diverting irrigation water through Riverside Heading, with the stipulation that the temporary dam would be removed once the American Canal Extension, scheduled for completion in February 1999, was constructed.

The other important joint project with Mexico, the Rio Grande Boundary Preservation Project, carries out the provisions of Article IV of the 1970 "Treaty to Resolve Pending Boundary Differences and Maintain the Rio Grande and Colorado River as the International Boundary". The project covers the Rio Grande's 194-mile reach between Fort Quitman and Haciendita, Texas and addresses sedimentation as well as the phenomenon of salt cedars choking the channel. In some places the channel is nearly obliterated, and lands on both sides of the river are subject to periodic flooding from flash floods of tributary arroyos. The final Environmental Impact Statement for the Boundary Preservation Project was completed in 1978. In the United States, the Boundary Preservation Project was constructed in reaches based on contracts issued and inspected by the IBWC's United States Section.

Construction was completed for Reach I but was interrupted for other reaches by an extended period of flooding in 1981. Subsequent work done by IBWC's United States Section was tied to the Mexican Section's schedule; February of 1986 marked the end of U.S. Section construction work anywhere within the Boundary Preservation Project.

Funding to continue maintenance of the completed channel work has not been received since 1985; consequently, sediment plugs on the large tributary arroyos and high flows in the river have caused overtopping of the banks with the result that the channel has deviated from its original alignment. It is this deviation from channel alignment that concerns IBWC and which is properly termed "re-channelization".

IBWC's perspective is that re-channelization of the Rio Grande is a treaty requirement, and that re-channelization offers some water salvage potential when combined with removal of salt cedar.

3.1.8 Forgotten River Reach of the Rio Grande

Reduced flows below Fort Quitman have resulted in a long stretch of the Rio Grande (locally known as the "Forgotten River") with no defined channel and riparian vegetation that has become a tamarisk thicket. The Rio Grande within this reach follows a sinuous channel for a distance of almost 200 river miles from about 13 miles downstream of Fort Quitman, Hudspeth County, to about 6 miles upstream of Presidio, Presidio County. The high flows and periodic floods necessary to maintain the river channels have been reduced significantly over the past several decades.

In 2004, the Texas Commission on Environmental Quality (TCEQ) voiced concerns related to floodplain and riverine function, environmental resources, water quality, agriculture, and watershed hydrology. At the request of TCEQ, the Albuquerque Division of the US Army Corps of Engineers conducted a reconnaissance level investigation of the Forgotten River, which culminated in recommendations that the "Forgotten River Reach" study proceed into the feasibility phase to develop comprehensive watershed management recommendations. In response, several studies have been conducted that examine environmental resources, water supply, groundwater recharge, flooding and erosion, geology, cultural resources, and history. The latest feasibility study by the US Army Corps of Engineers, published in August 2007, provides recommendations pertaining to a needed systematic watershed approach to understanding the dynamics of the river environment. The study also presents an opportunity for local, state, and federal agencies to work together in developing solutions to managing the varied resources of the Forgotten River Reach. This document can be accessed at http://www.transpecoswatertrust.com/cschap1.html.

3.2 PECOS RIVER

The Pecos River is the largest Texas river basin that flows into the Rio Grande. Originating in New Mexico, the Pecos flows southerly into Texas, and discharges into the channel of the Rio Grande near Langtry in Val Verde County. The River forms the easternmost border of Far West Texas along the northeast corner of Terrell County. Flows of the Pecos River are controlled by releases from the Red Bluff Reservoir near the Texas – New Mexico state line. Storage in the reservoir is affected by the delivery of water from New Mexico. According to data of the IBWC, the Pecos River contributes an average of 11 percent of the annual streamflow into the Rio Grande near Amistad Reservoir. The Pecos also contributes more than 29 percent of the annual salt loading into the reservoir.

3.2.1 Pecos River Compact

The Pecos River Compact provides for the apportionment and diversion of Pecos River waters. The interstate administrative agency known as the Pecos River Compact Commission administers the Compact. This Compact repeatedly refers to the “1947 Condition,” which is a Pecos River Basin situation defined in the Compact Commission’s Report of the Engineering Advisory Committee. The term “unappropriated flood waters” includes Pecos River waters originating above the Red Bluff Dam located in Texas at the New Mexico/Texas border. The impoundment will not deplete the water usable by the storage and diversion facilities under the 1947 condition. If not impounded, the water will flow past Girvin, Texas. The terms of the Pecos River Compact can be summarized by the following four points:

- New Mexico cannot decrease the Pecos flow at the New Mexico/Texas border to a point less than that of the 1947 condition. (When determining the quantity of Texas water for the 1947 condition, waters of the Delaware River are apportioned to Texas.)
- Of the beneficial consumptive use of water salvaged in New Mexico on the River, Texas shall receive 43 percent and New Mexico 57 percent.
- Any water salvaged by beneficial use, but which is not beneficially consumed, shall be apportioned to New Mexico. Any water salvaged in Texas shall go to Texas.
- Beneficial consumptive use of unappropriated floodwaters shall go equally to Texas and to New Mexico.

The Pecos River Compact allows Texas and New Mexico to build additional reservoir capacity to replace unusable reservoir capacity, for the utilization of salvaged water and unappropriated floodwaters as apportioned by the Compact and for making more efficient use of water. Each state shall work with agencies to solve the salinity problem in the Pecos, and each may construct and operate facilities to prevent flood damage.

The two states were involved in a lawsuit that was decided in March 1988. The decree required New Mexico to abide by the terms of the Pecos River Compact. It also resulted in the appointment of a Pecos Rivermaster.

3.2.2 Water Allocation and Water Rights

Waters delivered to Texas are stored in Red Bluff Reservoir and are allocated by a master irrigation control district to seven other irrigation districts downstream. Each district apportions the waters to individual farmers. The irrigation districts are located in Loving, Ward, Reeves and Pecos Counties, which lie in Far West Texas' neighboring Region F.

Within the reach of the Pecos that borders Far West Texas, the TCEQ water-rights master file lists only two water rights on unnamed tributaries of the Pecos River. These water-rights holders, both located in Terrell County, are authorized to divert 44.6 and 0.6 acre-feet of water per year for irrigation purposes.

3.2.3 Significant Pecos River Basin Tributaries

Phantom Creek – Phantom Creek originates from groundwater discharging at Phantom Spring in Jeff Davis County. The Creek flows northeastward into Reeves County, where it gains additional flow from San Solomon, Giffin, Saragosa, East Sandia and West Sandia Springs; however, surface flow in the Creek does not reach the Pecos River. Phantom Creek is an important source of water for irrigation in southern Reeves County. The U.S. Bureau of Reclamation manages the spring property and holds two water rights for the annual diversion of as much as 18,900 acre-feet of water for irrigation.

According to a study performed by the TWDB in 2003, flow in Phantom Spring has experienced significant decline over the past several drought years, declining from more than 10 cubic feet per second (cfs) during the 1930s to less than 1 cfs during the most recent drought period. Recently on several occasions, Phantom Spring has actually ceased flowing and a pump has been installed into the spring pool to support species residing at the spring outfall.

Independence Creek – Independence Creek, a large spring-fed creek in northern Terrell County, is the most important of the few remaining freshwater tributaries to the lower Pecos River. Caroline Spring flows at a rate of 3,000 to 5,000 gpm and comprises about 25 percent of the Creek's flow. 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).

Independence Creek hosts a variety of bird and fish species, some of which are extremely rare. For the Proserpine shiner, Rio Grande darter, headwater catfish, and several other native fishes, Independence Creek is an important refuge during stressful Pecos River conditions. Following periods of low-water quality and occasional algae blooms on the Pecos River, fish populations in the clear waters of the Creek help to repopulate the River after a fish kill. The Nature Conservancy of Texas manages a significant portion of Independence Creek, including Caroline Spring, as a natural preserve.

3.2.4 Pecos River Basin Assessment Program

The Pecos River is the lifeblood of many communities within its reaches, and serves as a major water source for irrigation, recreational uses, and recharge for underlying aquifers. However, the flows of the once great Pecos River have dwindled to a mere trickle due to natural and man-induced causes. Because water quality and streamflow has declined, the aquatic community of the Pecos River has been drastically altered. To address these river issues, the Pecos River Basin Assessment Program was initiated in 2004 by the various facilities of Texas A&M University (http://pecosbasin.tamu.edu/). The project is funded by the Texas Soil and Water Conservation Board through the U.S. Environmental Protection Agency-Clean Water Act Grant. Components of the project include:

- A basin assessment of stream channel morphology, riparian vegetation, land use, salinity mapping, water inflows and outflows, aquatic habitats, historic perspectives and economic modeling.
- Educational programs working with various state and local agencies to assemble a series of publications and organize and conduct a series of educational meetings targeted at landowners, stakeholders and policymakers in the Basin.
- Monitoring programs consisting of data collection, analysis, and water use studies intended to estimate the effect of salt concentration and fate of water salvaged through salt cedar control in the Pecos River Watershed.

"A Watershed Protection Plan for the Pecos River in Texas" was published in 2008 (http://pecosbasin.tamu.edu/media/1923/PecosRiverWPP.pdf) and contains the following:

The WPP for the Pecos River in Texas recommends management strategies that typically address more than one concern. The plan includes an in-depth overview that defines the watershed and its characteristics and provides some of the history behind the current issues. As a primer on management strategies, the WPP also discusses past and current uses of the river and watershed. Landowners' concerns about the Pecos River watershed are discussed, management strategies are recommended, costs are estimated, technical assistance is outlined, and timelines for implementing these strategies and a program to address each concern are included. The plan includes:

- Identification of the causes and sources of pollutants
- Estimation of expected pollutant reductions
- Identification of critical areas of the watershed
- Description of the management measures needed
- Estimation of the costs of technical assistance and sources of funding
- An information and educational outreach component
- A feasible implementation schedule
- Milestones to assess the effectiveness of plan implementation
- Criteria for assessing success
- A long-term monitoring effort

3.3 GROUNDWATER

Other than irrigation use and a portion of City of El Paso municipal use from the Rio Grande, almost all other water use in Far West Texas is supplied from groundwater sources. Although not as large in areal extent as some aquifers in the State, such as the Ogallala and the Carrizo-Wilcox, individual aquifers in Far West Texas are more numerous (13 TWDB designated and 4 local) than in any of the other planning regions (Figure 3-2).

- Hueco Bolson
- Mesilla Bolson
- West Texas Bolsons
    - Salt Basin
        - Upper Salt Basin
        - Wild Horse and Michigan Flats
        - Lobo Flat
        - Ryan Flat
    - Presidio / Redford
    - Green River Valley
    - Red Light Draw
    - Eagle Flat
- Bone Spring-Victorio Peak
- Igneous
- Edwards-Trinity (Plateau)
- Capitan Reef
- Marathon
- Rustler

Other locally recognized groundwater sources:

- Rio Grande Alluvium
- Edwards-Trinity of Brewster and Presidio Counties
- Balmorhea Alluvium
- Diablo Plateau

Aquifers in the Region can be categorized into three basic types; bedrock, bolson and alluvium. Bedrock aquifers are those where groundwater flows through permeable fractures in hard-rock formations (limestone, dolomite, volcanic basalt, etc.). Aquifers of this type include the Bone Spring-Victorio Peak, Capitan Reef, Edwards-Trinity, Rustler, Marathon, and Igneous. Bolson aquifers occur in thick silt, sand,

and gravel deposits that fill valleys between the numerous mountain ranges. Bolson aquifers in the Region include the Hueco, Mesilla, and the various individual aquifers that comprise the West Texas Bolson Aquifer group. Alluvial aquifers occur in the floodplain deposits adjacent to riverbeds and are often times hydrologically connected to the surface water body. The Rio Grande Alluvium Aquifer is in this category. Water quality characteristics of these aquifers are discussed in Chapter 1, Section 1.8.

The FWTWPG has continuously acknowledged the need to increase the reliability of groundwater availability estimates by supporting the acquisition of additional data that can be used to characterize the many aquifers in the Region. Interim TWDB funded projects were performed during previous planning periods in which new well data, water quality analyses, and aquifer parameters ascertained through pumping tests were developed. Project reports are accessible on the Rio Grande Council of Government website at http://www.riocog.org/ENVSVCS/FWTWPG/docs.htm.

- Igneous Aquifer System of Brewster, Jeff Davis and Presidio Counties, Texas (2001)
- West Texas Bolsons and Igneous Aquifer System Groundwater Availability Model Data Collection (2003)
- Groundwater Data Acquisition in Far West Texas (2009)
- Groundwater Data Acquisition and Analysis for the Marathon and Edwards-Trinity (Plateau) Aquifers (2010)

The evaluation of groundwater availability as reported in this *2016 Plan*, including MAG volumes and local analyses, is based on previous geohydrologic studies, groundwater data including historical use contained in state and federal databases, and groundwater availability models (GAMs). Regardless of the specific method used to calculate groundwater supply availability, all analyses include the consideration of four basic components: (1) recharge to the aquifer, (2) recoverable storage capacity within the aquifer, (3) lateral movement into and out of the aquifer, and (4) withdrawals from the aquifer.

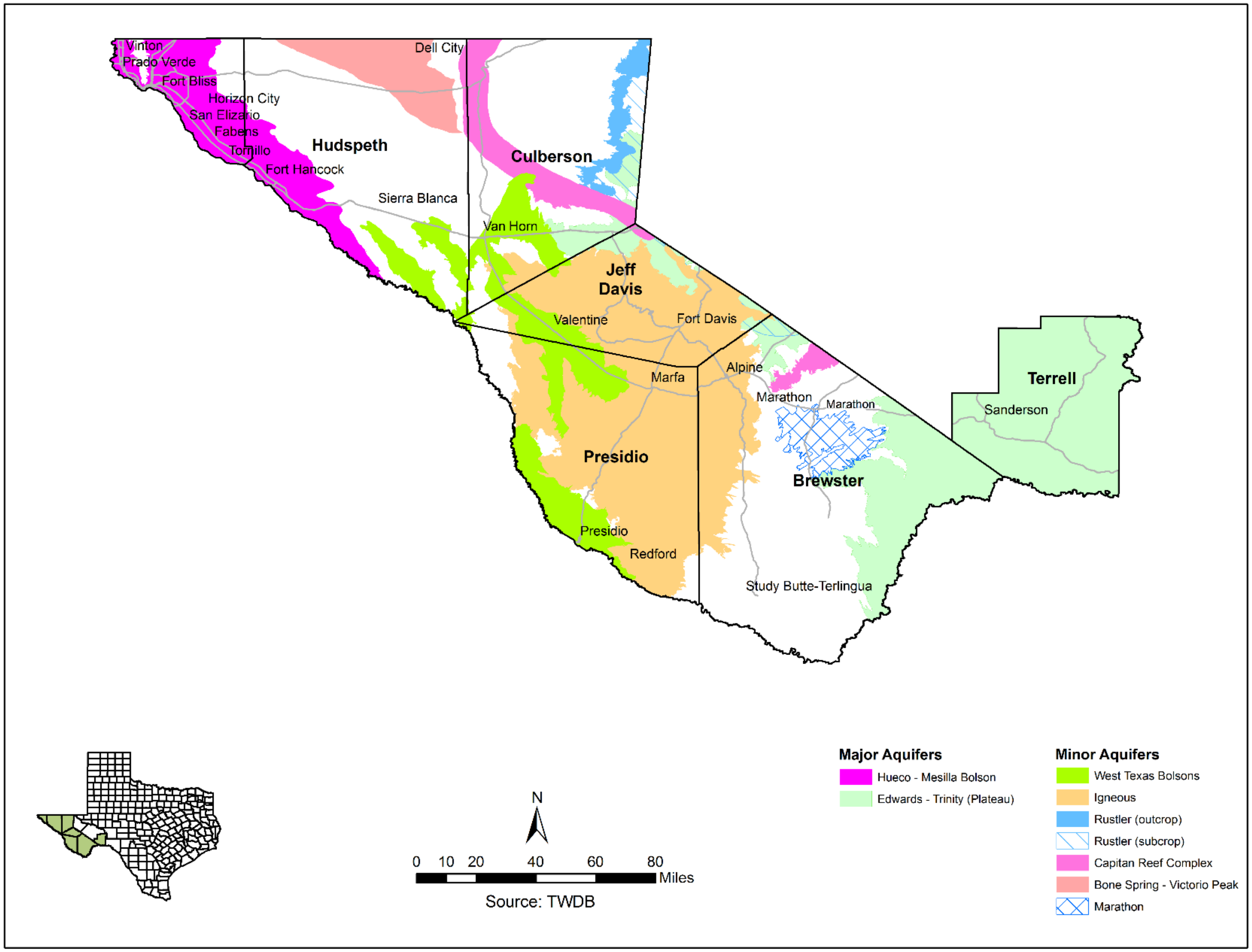


Figure 3-2. Major and Minor Aquifers

3.3.1 Hueco Bolson Aquifer

The Hueco Bolson Aquifer is a major source of groundwater for cities in El Paso and Hudspeth Counties, as well as Ciudad Juarez, Mexico. The Hueco Bolson extends southeastward from the Franklin Mountains in El Paso County to the southern end of the Quitman Mountains in Hudspeth County. The eastern boundary of the bolson is established by the Diablo Plateau in El Paso and Hudspeth Counties and the Malone and Quitman Mountains in Hudspeth County. Northward, the Hueco extends into New Mexico where it is hydrologically connected to the Tularosa Basin Aquifer. The Hueco Bolson also extends southward into the Mexican State of Chihuahua, where it is bounded by a series of mountain ranges that trend toward the southeast from Ciudad Juarez to near the southernmost point of the Quitman Mountains in Texas.

The Hueco Bolson consists of deposits of basin fill with a maximum thickness of approximately 10,000 feet along its western edge. The upper part of the basin fill consists of silt, sand and gravel. The lowermost deposits are made up largely of clay and silt. Only portions of the upper several hundred feet of the bolson fill are known to contain fresh to slightly saline water. A wedge of fresh water increases to a maximum depth at or near the western edge of the aquifer. East of the fresh water zone, the aquifer contains large volumes of brackish quality groundwater, which is currently being desalinated for public supply use by EPWU and Horizon MUD. Where Hueco Bolson sediments directly underlie Rio Grande alluvial sediments, the two units are hydrologically connected. Recent data analysis and computer modeling indicate that the Hueco Bolson Aquifer can continue to be sustainably developed well beyond previous estimates.

In the most recently completed flow model, Hutchison (2006) estimates a total annual supply of water in storage in the Hueco Bolson Aquifer of 45.5 M acre-feet (9.4 M fresh, 36.1 M brackish). For this *Plan,* a total of 480,000 acre-feet per year, or one percent of the annual storage volume, is considered for sustainable use (162,000 fresh, 318,000 brackish).

3.3.2 Mesilla Bolson Aquifer

The Mesilla Bolson Aquifer is located west of the Franklin Mountains and is part of a larger bolson that extends from southern New Mexico to northern Mexico. The bolson deposits consist of approximately 2,000 feet of clay, silt, sand, and gravel. Three water-bearing zones have been identified based on water levels and quality. The shallow zone includes the overlying Rio Grande Alluvium. The City of El Paso maintains a municipal well field in the Mesilla Bolson Aquifer near Canutillo.

3.3.3 West Texas Bolsons Aquifer

3.3.3.1 Salt Basin Bolson

The Salt Basin is the largest of the West Texas Bolson Aquifers extending from the New Mexico state line on the western side of the Guadalupe Mountains southward to near Marfa in northern Presidio County. The basin is subdivided into five distinct but hydrologically connected areas referred to as "flats" that contain significant quantities of groundwater that are being produced for both municipal, irrigation, and livestock use. These sub-aquifers include from north to south Upper Salt, Wild Horse, Michigan, Lobo, and Ryan Flats.

Upper Salt Basin is not currently designated as part of the TWDB-designated West Texas Bolsons Minor Aquifer system, but is listed here because it is recognized as a source supply for specified water-user categories in this *Plan*. The Upper Salt Basin is the northern extension of Wild Horse Flat and is described separately because of a difference in water quality and primary use. The aquifer generally produces brackish to slightly saline groundwater to low-capacity wells primarily serving livestock needs.

Wild Horse Flat and Michigan Flat lie to the south of the Upper Salt Basin and are hydrogeologically interconnected with the northernmost part of Lobo Valley. Mountains bound the Wild Horse-Michigan Flat area along its western, eastern and southeastern margins. The Wild Horse-Michigan Flat watershed covers an area of approximately 1,000 mi^2 with a storage area of approximately 375 mi^2. The Wild Horse Flat area of the basin is a source of municipal supply for the Towns of Van Horn (Culberson County) and Sierra Blanca (Hudspeth County). The Wild Horse-Michigan Flat Aquifer is a major source of domestic and stock water for ranches and of irrigation water for farms in the valley.

Lobo Flat lies southwest of Wild Horse and Michigan Flats and is bound by mountains along its western and eastern margins. The bolson watershed covers an area of 350 mi^2, with a groundwater storage area of 130 mi^2. The largest part of the storage area (75 mi^2) is in Culberson County, and a smaller part (55 mi^2) lies within Jeff Davis County. The bolson is not a source of municipal supply for any town in Jeff Davis County or Culberson County. It is, however, a source of domestic and stock water for ranches and is also a significant source of irrigation water.

Ryan Flat is the southernmost extension of the Salt Basin. The bolson watershed covers an area of 1,410 mi^2, and the storage area is 525 mi^2. The largest part of the storage area (360 mi^2) is in Presidio County, and a smaller area (165 mi^2) extends northward into Jeff Davis County. The bolson is the source of municipal supply for the Town of Valentine (Jeff Davis County). It is also the source of domestic water, stock water for ranches, and a source of irrigation water for farms.

Well completion information and pumping records from the Antelope Valley Ranch owned by EPWU indicate that a zone of saturated, permeable, fractured volcanic rocks from 1,000 to as much as 3,000 feet thick underlies the bolson fill in Ryan Flat.

3.3.3.2 Presidio-Redford Bolson

In Texas, the Presidio-Redford Bolson extends along the Rio Grande from Candelaria to outcrops of volcanic rocks 6 to 10 miles southeast of Presidio. The Redford extension of the bolson continues along the Rio Grande for another 12 miles. The bolson is bounded along the northeast by the Chinati Mountains and along the southeast by the Cienega Mountains, the Black Hills, and the Bofecillos Mountains. The southwestern boundary of the bolson in Texas is the Rio Grande. This is an area of approximately 480 mi^2. Saturated thickness is conservatively estimated to be 500 feet beneath this area. The Presidio-Redford Bolson is the source of municipal supply water for the Town of Presidio. It is also the source of domestic water, irrigation water and stock water for ranches and farms.

3.3.3.3 Green River Valley Bolson

The Green River Valley Bolson lies in parts of Hudspeth, Jeff Davis and Presidio Counties. It is bordered by the Eagle Mountains on the west, the Van Horn Mountains on the east, and the Rio Grande on the south. The Green River Valley watershed covers an area of 160 mi^2, however the storage area is only 40 mi^2. Green River Valley is the smallest of the West Texas Bolsons and is a source of water only for ranches in the basin. A few abandoned wells give witness to a past history of irrigation.

3.3.3.4 Red Light Draw Bolson

Red Light Draw, located in Hudspeth County, is situated between the Eagle Mountains along the north-northeast and the Quitman Mountains along the southwest. The Rio Grande is the southern border of the basin. The drainage area of the Red Light Draw watershed is estimated to be 370 mi^2 and an aquifer area of 185 mi^2. The Red Light Bolson is a source of water only for ranches in the basin, and at its southern end for a research station operated by the University of Texas at El Paso.

3.3.3.5 Eagle Flat Bolson

The Eagle Flat Bolson, located in Hudspeth County, is situated between the Eagle Mountains along the south-southwest, the Diablo Plateau along the north, and the Carrizo and Van Horn Mountains along the east. The drainage area of the bolson watershed is estimated to be 560 mi^2 and the basin fill covers an area of 156 mi^2. Only the southeastern part of the basin is regarded as having potential for the development of groundwater resources. The Eagle Flat Bolson is not a source of supply for municipalities in Hudspeth County. The unincorporated Town of Sierra Blanca, located in the western region of the basin, gets water from a well field operated by the Town of Van Horn in Wild Horse Flat.

3.3.4 Bone Spring-Victorio Peak Aquifer

The Bone Spring-Victorio Peak Aquifer underlies the Dell Valley area of northeastern Hudspeth County between the Salt Flat Basin and the Guadalupe Mountains on the east and the Diablo Plateau on the west. The aquifer, which extends northward into the Crow Flats area of New Mexico, is used primarily for irrigation, but is also the public water supply source for Dell City. In 2007 the TWDB significantly enlarged the designated area of the aquifer to a total of 710 mi^2 by extending its western and southern boundary.

The aquifer consists of carbonate rocks (limestone and dolomite) of early Permian age. Groundwater in the aquifer occurs under water-table conditions in interconnected solution cavities of variable size and dimension that formed along joints, fractures and bedding planes. Water-bearing zones have been encountered in wells as deep as 2,000 feet. The productivity of a well completed in the aquifer is dependent on the number and size of cavities penetrated by the well bore. Well yields are reported to range from 150 gpm to as much as 4,000 gpm. The depth to groundwater within the irrigated region of Dell Valley ranges from approximately 35 feet along the eastern side of the valley to 325 feet on the west. Although the water table has declined since pre-development, static water levels have remained relatively constant since the late 1970s.

There are four principal components of recharge to the Bone Spring-Victorio Peak Aquifer:

- Precipitation that falls over watersheds that drain toward Dell Valley infiltrates rapidly along fractures and solution features such as sinkholes;
- The Sacramento River, which drains the Sacramento Mountains of New Mexico, discharges large volumes of water to the subsurface in the lowlands that border the mountain catchments;
- Lateral inflow of groundwater from areas to the north and the west; and
- Return flow from irrigation in Dell Valley.

During the irrigation season, the flow of groundwater is highly influenced by pumping wells, which create cones of depression in the water table. The cones of depression may induce the flow of highly saline water from the Salt Flats toward the pumping wells by reversing the flow of groundwater along the eastern side of the valley. However, chemical analyses of wells along the eastern border of the valley have not indicated a significant influx of saline water.

3.3.5 Igneous Aquifer

The Igneous Aquifer system comprises all contiguous Tertiary igneous (volcanic) formations underlying the Davis Mountains and adjacent areas primarily in Brewster, Jeff Davis and Presidio Counties. Most of the aquifer's areal extent is underlain by a thickness ranging from 1,000 to 4,000 feet; however, most wells are less than 1,000 feet in depth. The aquifer is not a single homogeneous aquifer but rather a system of complex water-bearing formations that are in varying degrees of hydrologic communication.

The extent of the Igneous Aquifer as illustrated in Figure 3-2 represents a new boundary established in recent studies of the aquifer system. Groundwater is stored in the fissures and fractures of intrusive and extrusive rocks of volcanic origin. The chemical quality of the aquifer is generally good to excellent and well yields generally range from small to moderate.

Over 40 separately named volcanic units have been identified, each of which are highly variable in nature. Water quality of the aquifer is relatively good and generally meets safe drinking water standards. Alpine, Marfa and Fort Davis, along with a growing rural population, derive their municipal supplies from this aquifer.

3.3.6 Edward-Trinity (Plateau) Aquifer

The Edwards-Trinity (Plateau) Aquifer in Far West Texas is the westernmost extension of a vast groundwater system that underlies the Edwards Plateau east of the Pecos River and the Stockton Plateau west of the River. The aquifer is exposed over an area of 4,690 mi^2 in Terrell (2,350 mi^2), Brewster (1,460 mi^2), Jeff Davis (530 mi^2) and Culberson (350 mi^2) Counties. It is the source of municipal water for the City of Sanderson (Terrell County); a source of domestic water in Brewster, Culberson, and Terrell Counties; a source of irrigation water in Brewster and Terrell Counties; a source of stock water in all four counties; and a source of water for oil and gas operations in Terrell County.

The aquifer consists of saturated sediments of the Cretaceous age Trinity Group formations and the overlying carbonate rocks (limestone and dolomite) of the Comanche Peak, Edwards, and Georgetown formations. Groundwater occurs under water-table conditions in the four Far West Texas counties.

The hydrogeology of the Edwards-Trinity (Plateau) Aquifer in Far West Texas is not understood as well as in areas to the east, where the aquifer is a major source of supply for the municipal, industrial and agricultural sectors of the economy.

3.3.7 Capitan Reef Aquifer

The Capitan Reef formed along the margins of the Delaware Basin, a Late Paleozoic sea. In Texas, the reef formed along the western and eastern edges of the basin in arcuate strips 10 to 14 miles wide. The reef is exposed in the Guadalupe and Apache Mountains of Culberson County and in the Glass Mountains of Brewster County. In other areas, the reef is found only in the subsurface. It extends northward into New Mexico, where it is a source of fresh water for the City of Carlsbad. The Capitan Reef Aquifer is composed of up to 2,000 feet of massive to cavernous dolomite and limestone, bedded limestone and reef talus. In many areas of Culberson and Hudspeth Counties, the yields of wells are commonly more than 1,000 gpm. Further to the south, in the Apache Mountains of Culberson County, well yields appear to be in the range of 400 gpm. There is no reported production data for the Glass Mountains portion of the Capitan Reef.

The aquifer is not currently a source of municipal supply; however, El Paso Water Utilities owns land over the aquifer in Culberson County and may tap the aquifer for municipal supply in the future. Most of the groundwater pumped from the aquifer in Far West Texas is used for irrigation in Culberson and Hudspeth Counties.

3.3.8 Marathon Aquifer

The Marathon Aquifer is located entirely within the north-central area of Brewster County, where it is the source of municipal supply for the Town of Marathon, and of domestic and stock water for ranches in the area. The Marathon area is underlain by complexly faulted and folded Paleozoic rocks having a total thickness of 21,000 feet and occupy an area of approximately 390-mi^2. The most significant water-bearing formation of the aquifer is the Marathon Limestone (early Ordovician age).

Groundwater in the Marathon Aquifer generally occurs under unconfined conditions in crevices, joints and cavities; however artesian conditions are common in areas where the Paleozoic rocks are buried beneath younger formations. Existing water wells have penetrated up to 900 feet, however most wells are generally less than 250 feet deep. Many of the shallow wells in the area actually produce water from alluvial deposits that overlie rocks of the Marathon Aquifer. The depth to groundwater is generally less than 150 feet, and depths of less than 50 feet are not uncommon. Groundwater in the aquifer is typically of good quality but hard.

3.3.9 Rustler Aquifer

The Rustler Aquifer is located in eastern Culberson County, where it is exposed in a southwest-trending belt that begins at the northeast corner of the county. The aquifer dips toward the east, and is found in the subsurface in easternmost Culberson County and Jeff Davis County. Approximately 803 mi^2 of land in Far West Texas are underlain by the Rustler Aquifer. The Rustler Aquifer is a source of water for irrigation and livestock. High concentrations of dissolved solids render the formation unsuitable as a source of municipal and domestic supply. The Rustler Aquifer consists mainly of dolomite, limestone, and gypsum of the Rustler Formation (Permian age). Groundwater is produced primarily from solution channels, caverns and collapsed breccia zones. The aquifer is under water-table conditions in the outcrop recharge zone in eastern Culberson County and is under artesian conditions elsewhere.

3.3.10 Other Groundwater Resources

Also shown in Figure 3-2 are large areas of Far West Texas that are depicted as not underlain by major or minor aquifers. The map, however, should not be interpreted as an indication that such areas are devoid of groundwater, but rather as a reflection of the current level of understanding of the extent of known groundwater resources in the Region.

Rio Grande Alluvium Aquifer

The Rio Grande Alluvium forms the flood plain of the Rio Grande in El Paso and Hudspeth Counties. Averaging approximately 200 feet in thicknesses, the alluvial aquifer is hydrologically connected to the underlying Hueco Bolson. TWDB Report 246 states that the Rio Grande Alluvium Aquifer within El Paso County contains about 1.4 million acre-feet of theoretically recoverable groundwater having less than 2,500 mg/l dissolved solids. Groundwater contained within the Rio Grande alluvial sediments generally has high concentrations of dissolved solids (typically greater than 2,000 mg/l), and requires desalination to meet drinking-water standards. However, it is a source of irrigation water in El Paso and Hudspeth Counties whenever flow in the Rio Grande is insufficient to support agricultural operations. These irrigation wells are capable of annually producing approximately 80,000 acre-feet in El Paso County and 15,000 acre-feet in Hudspeth County from the Aquifer. In addition, the Horizon Regional MUD pumps alluvial groundwater for municipal use, which must be desalinated to meet safe drinking water standards.

For the purpose of this *Plan*, groundwater availability from the Rio Grande Alluvial Aquifer in El Paso County is calculated as 89,330 acre-feet per year effective recharge plus 5 percent of water in storage to a depth of 200 feet and with a salinity range of 1,000 to 2,000 mg/l (TWDB Rept. 246), or 130,380 acre-feet per year. Groundwater availability from the Aquifer in Hudspeth County is estimated at approximately 11.5 percent of that in El Paso County, or 15,000 acre-feet per year.

Edwards-Trinity Aquifer of Brewster and Presidio Counties

In southern Brewster County, the small communities of Study Butte and Terlingua, as well as the Lajitas Golf Resort, obtain groundwater from underlying Cretaceous formations that are geologically equivalent to the Edwards-Trinity (Plateau) Aquifer. Wells recently drilled to supply water for the Lajitas golf courses have demonstrated that groundwater of likely significant quantity is present in this aquifer system. However, very little data has been collected pertaining to this aquifer. The Lajitas' wells are relatively deep, the temperature of the water is warm, and the water contains elevated radioactivity. The FWTWPG recommends that this aquifer be studied in more detail.

Balmorhea Alluvium Aquifer

The Balmorhea Alluvium Aquifer, located in a small area along the Jeff Davis and Reeves county line, is recognized in this *Plan* due to its use as a municipal supply source for the City of Balmorhea and the Madera Valley WSC. The TWDB classifies this area as belonging to the Pecos Valley Aquifer; however, the erosional derived gravel sequence is much unlike the sand and silts of the Pecos Valley Alluvium, and recharge is also unique to runoff from the slopes of the Davis Mountains.

Diablo Plateau Aquifer

The Permian and Cretaceous rock formations that make up the subsurface of the Diablo Plateau of central and northern Hudspeth County may have large volumes of groundwater in storage. Although the aquifer system has not been adequately researched, Hutchison (2008) included a portion of this aquifer system in a flow simulation model of the Bone Springs-Victorio Peak Aquifer. Also a number of wells have been drilled that testify to the existence of an underground supply.

For the purpose of this *Plan*, groundwater availability for the eastern and southern portion of the Diablo Plateau is conservatively calculated as 26,400 acre-feet per year effective recharge based on three percent (drought rate) of average annual rainfall (11 inches) times the areal extent of the designated portion of the aquifer (1,500 mi² or 960,000 acres).

3.3.11 Groundwater Conditions in Municipal Well Fields

3.3.11.1 Brewster County

City of Alpine – The City of Alpine operates 15 active municipal supply wells in three well fields (the Musquiz, Sunny Glen, and Town well fields). Water levels have remained relatively stable in the vicinity of the well fields, and there are no reported major water quality problems. The Musquiz field produces approximately 66 percent of the City's municipal water, but the Sunny Glen field is regarded as having greater storage capacity. Recently, several wells within the Sunny Glen field were deepened, and yields are reported to have increased from less than 100 gpm to as much as 500 gpm. The City is actively upgrading both its well fields and its distribution system.

Community of Marathon – The Marathon Water and Sewer Service Corporation provides water to the Community of Marathon from two wells screened in the Marathon Aquifer. Water levels have remained stable in the vicinity of the Community, and there are no reported major water quality problems. There are no other sources of groundwater in the vicinity of the Community.

Communities of Terlingua and Study Butte – The Terlingua Study Butte Water Supply Corporation (WSC) has developed two wells into the Cretaceous Santa Elena Limestone. The capacity of either well is sufficient to supply daily needs. Water levels have remained relatively stable, but little is known about how high production wells into the same formation 10 miles away might affect local static water levels. Radiological activity in the untreated water consists mainly of Radon gas and radium 226, which are present in levels barely above detection limits. Radon levels are drastically reduced by mechanically assisted gassing, and the particulate R226 can be filtered out in such a quantity as to leave both an excellent product water and to pose no problems for disposal. This water system has one of the most sophisticated rural public water treatment facilities in West Texas, combining reverse osmosis desalination and other more traditional technologies to produce a product of superior taste and quality.

Resort of Lajitas – The Resort of Lajitas currently relies on two deep, large-bore wells of varying water quality drilled into Cretaceous formations. Depending on location, wells have demonstrated artesian characteristics, with completed static level as much as 700 feet above the level where the formation was entered. The water is chemically similar to that found 10 miles away by the Terlingua Study Butte WSC, and poses similar treatment problems. The majority of water produced by the Lajitas Resort water system is for golf course and turf irrigation from a combination of sources. A state-of-the-art electro-dialysis desalination plant provides high quality product for municipal use by residents, employees, and resort guests. No change in aquifer levels has been reported since the onset of high volume pumping in 2000, but little reliable data is available for either recharge rates or total pumping volumes.

3.3.11.2 Culberson County

Town of Van Horn – Municipal supply for the Town of Van Horn is derived from four active city-owned wells in the Wild Horse Flat Aquifer. Water levels in the vicinity of Van Horn have remained stable. Other than fluoride concentrations that have been reported to range from 2.3 to 3.1 mg/l, all other dissolved constituents are within their respective safe drinking-water standards. The current well field has significant expansion capability if additional production is needed to meet increased demand. The City is currently replacing all water meters in order to better monitor water use.

3.3.11.3 El Paso County

City of El Paso and Vicinity – The production of groundwater from well fields in the vicinity of El Paso and in Ciudad Juarez has created a large cone of depression in the potentiometric surface beneath each city. Average declines in wells in the upper portion of the Lower Valley in El Paso are in excess of 100 feet. These declines, in combination with deteriorating water quality, have prompted the City to discontinue pumping from certain wells. Elsewhere, average water-level declines are generally in the range of 60 to 80 feet. Recent water-level data indicate a slight rise of water levels in the valley. This is probably traceable to lower pumpage in some areas. The lowering of the potentiometric surface not only has reversed the predevelopment hydraulic gradient in the westernmost regions of the Hueco Bolson, but also is a factor underlying the deterioration of water quality in part of the El Paso area.

The concentrations of chloride and other dissolved ions have increased in many of the municipal wells of both cities. In El Paso County, for example, the TDS in production wells has risen to more than 1,000 mg/l. In recent years, El Paso Water Utilities (EPWU) has taken approximately 30 wells out of service due to elevated levels of chloride and TDS. In many cases, the greatest increases in TDS are associated with wells that have had large, sustained drawdowns, but similar changes have also been observed in some wells from which much less pumping has occurred. To continue the use of some of the more brackish quality wells, EPWU has installed skid-mounted desalination equipment. EPWU and El Paso County Tornillo WID are installing treatment facilities to mitigate elevated arsenic levels in groundwater supplies.

3.3.11.4 Hudspeth County

Community of Sierra Blanca – Water provided to the Community of Sierra Blanca by the Hudspeth County Water Control and Improvement District #1 is from a well located near the airport northwest of the Town of Van Horn in Culberson County. The well produces groundwater from the Wild Horse Flat Aquifer where water levels in the vicinity of the well have remained relatively constant and water quality has been acceptable. There is substantial room for expansion if an additional well is needed to meet increased demand. Since 1970, Sierra Blanca has drilled as many as five wells in Hudspeth County in unsuccessful attempts to develop local sources of groundwater.

City of Dell City – Dell City relies on three wells (only one of which is currently active) completed in the Bone Spring-Victorio Peak Aquifer for municipal water, which is brackish and must be desalinated. The Bone Spring-Victorio Peak Aquifer is capable of supporting production from additional municipal supply wells if needed.

Communities of Fort Hancock and McNary – Fort Hancock and McNary have relied on groundwater provided by one well owned by the Fort Hancock WCID and on 11 wells owned by the Esperanza FWSD#1. All production is from the Rio Grande Alluvium Aquifer. Water levels fall in response to extended drought conditions in the region, but the owner of the Esperanza FWSD #1 reports that water levels usually recover quickly after periods of rainfall. Water quality is a problem in the area, as TDS ranges from approximately 1,000 mg/l to as much as 2,500 mg/l. Other dissolved solids in excess of drinking water standards are fluoride and manganese. The possibilities for expansion are limited by the occurrence of saline groundwater in both the Rio Grande Alluvium and the Hueco Bolson Aquifer.

3.3.11.5 Jeff Davis County

Community of Fort Davis – The Fort Davis Water Supply Corporation (FDWSC) provides water to the Community of Fort Davis and the surrounding area from three wells completed in the Igneous Aquifer. One of the wells is used only as a backup. Water levels in the vicinity of the wells have remained stable; and other than elevated fluoride, there are no reported problems with water quality. The FDWSC is currently considering an additional well in town and possibly connecting to a private public-supply well east of town.

Town of Valentine – The Town of Valentine relies on one municipal water supply well completed in the Ryan Flat Aquifer. A pumping test conducted on the well in 2004 produced at an average rate of 59 gpm with 201 feet of water level drawdown. A second well owned by the Valentine Independent School District provides water to the school and to a small number of residences occupied by teachers. Water levels in the vicinity of Valentine have remained stable, and there are no reported problems with water quality. Under consideration is a proposal to drill a second municipal water supply well. The Ryan Flat Aquifer appears to have ample capacity to support additional well development for Valentine.

3.3.11.6 Presidio County

City of Marfa – The City of Marfa depends on three city-owned wells for all of its municipal water needs. Two of the wells are capable of producing as much as 1,100 gpm, and the third well yields an additional 450 gpm. The Tertiary volcanics of the Igneous Aquifer are the source of groundwater. Other than fluoride, which has been reported at concentrations ranging from 2.5 to 3 mg/l, all other dissolved solids are below their respective safe drinking-water standards, and TDS are typically less than 400 mg/l. An additional well and a treatment facility to mitigate the fluoride issue are currently in the planning and design phase.

City of Presidio – The City of Presidio derives its municipal water from four wells located east of the City along Alamito Creek. The wells are approximately 530 feet in depth and produce from the Presidio Bolson Aquifer. A water quality analysis of one of the wells records a total dissolved solids level of 374 mg/l. Additional supply is needed to serve a developing area around the airport north of town.

3.3.11.7 Terrell County

Community of Sanderson – The Terrell County WCID#1 provides municipal water to the Community of Sanderson from 14 active public supply wells that produce groundwater from the Edwards-Trinity (Plateau) Aquifer. The wells are located in three fields; four in the north field, three in the middle field, and seven in the south field. Water levels have remained stable; and water quality is not reported to be a problem for the Community.

3.3.12 Groundwater Exports

Jeff Davis is the only county from which water is exported to other areas outside of its borders. As shown by Table 3-4 below, in 2014 the City of Alpine pumped 724 acre-feet from five wells in the Musquiz well field in southeastern Jeff Davis County. All other exports go to Reeves County. In 2014 the City of Balmorhea and the Madera Valley WSC extracted 140 and 44 acre-feet respectively, from the Balmorhea Alluvium in northeastern Jeff Davis County. Also, the U.S. Bureau of Reclamation has water rights for diversions of up to 18,900 acre-feet per year of surface water from Phantom Creek for irrigation use in Reeves County.

Table 3-4. Far West Texas 2013 Groundwater Exports
(Acre Feet per Year)

Received By	Receiving County	Source	Amount in 2014	Remarks
City of Alpine	Brewster	Igneous Aquifer	724	Pumpage from five wells in Musquiz well field
City of Balmorhea	Reeves	Balmorhea Alluvium	140	Pumpage from one well
Madera Valley WSC	Reeves	Balmorhea Alluvium	44	Pumpage from two wells
U.S. Bureau of Reclamation	Reeves	Phantom Creek	18,900	Permitted diversion for irrigation

Source: Jeff Davis County Underground Water Conservation District
Note: See Region F Water Plan for future water use projections for the Reeves County water user entities.

3.4 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 and irrigation. For planning purposes, the volume of runoff water in these catchment basins is considered to be significantly reduced during drought-of-record conditions and does not include any groundwater that might be pumped into them. Table 3-5 provides a listing of local supply volumes by County, River Basin, and Use that appear in the Region-wide listing of available supply sources (Tables 3-1 and 3-2). Supply volumes are based on a very subjective estimate of the number of stock tanks (each averaging approximately 5 acre-feet in volume) in existence as estimated from the total demand for livestock, mining, or irrigation in each county.

Table 3-5. Far West Texas Local Supply
(Acre-Feet per Year)

Source	Basin	County	Primary Use	Number of Tanks	Supply Volume in acre-feet / year					
					2020	2030	2040	2050	2060	2070
Local Supply	Rio Grande	Brewster	Livestock	4	19	19	19	19	19	19
		Culberson	Livestock	3	15	15	15	15	15	15
			Mining	16	78	78	78	78	78	78
		El Paso	Livestock	5	26	26	26	26	26	26
			Mining	605	3,026	3,026	3,026	3,026	3,026	3,026
		Hudspeth	Livestock	16	81	81	81	81	81	81
			Mining	48	240	240	240	240	240	240
		Jeff Davis	Livestock	5	25	25	25	25	25	25
			Irrigation	10	50	50	50	50	50	50
		Presidio	Livestock	8	41	41	41	41	41	41
		Terrell	Livestock	1	4	4	4	4	4	4
			Mining	8	40	40	40	40	40	40

3.5 REUSE

El Paso Water Utilities has nearly 40 miles of reclaimed water lines (purple pipeline) in place in all areas of the City. Reclaimed water serves the landscape irrigation demand of golf courses, parks, schools, and cemeteries, and also provides water supplies for steam electric plants and industries within the City. EPWU does not plan on extending or growing the purple pipe infrastructure, but will focus on maintaining existing purple pipe customers and work towards increasing the use of reclaimed water through additional purified water projects (see EPWU strategies in Chapter 5).

APPENDIX 3A
AUTHORIZED SURFACE WATER RIGHTS

This page intentionally left blank

APPENDIX 3A. AUTHORIZED SURFACE WATER RIGHTS AS EXTRACTED FROM TCEQ'S ACTIVE WATER RIGHTS MASTER FILE

Water Right	Water Right	Applica-tion	Amend-ment	Owner	Diversion	Use	Priority Date	Acreage	Reservoir Name	Reservoir C	Site Name	Basin	County
121	App/Perm	121		CLAYTON W WILLIAMS JR ET AL	124	D&L	9/13/19	0	RES 1, RES 2	16		Rio	Brewster
375	Cert Filing			US DEPT OF THE INTERIOR	900	Irr	6/25/19	300	PHANTOM LAKE		RIO GRANDE PROJECT.BUREAU OF	Rio	Jeff Davis
899	Cert of Adj			C & L COMPANY	60	Irr	2/12/19	20				Rio	Presidio
900	Cert of Adj			RAYMOND DIETERT ET AL	800	Irr	1/28/19	500		395		Rio	Hudspeth
900	Cert of Adj			RAYMOND DIETERT ET AL	700	Irr	1/1/19					Rio	Hudspeth
901	Cert of Adj			WILLIAM N ROTH ET AL	507	Irr	1/1/19	169				Rio	Hudspeth
902	Cert of Adj			SAMUEL S ARMENDARIZ JR ET AL	330	Irr	1/1/19	110				Rio	Hudspeth
902	Cert of Adj			ESTATE OF SIDNEY W COWAN		Irr	1/1/19					Rio	Hudspeth
903	Cert of Adj			DOUGLAS A JOHNSTON	63	Irr	1/1/19	21				Rio	Hudspeth
904	Cert of Adj			JIM B BEAN ET AL	831	Irr	1/1/19	277				Rio	Hudspeth
905	Cert of Adj			KATHRYNE ALICE G LOPEZ ET AL	330	Irr	1/1/19	141.6				Rio	Hudspeth
906	Cert of Adj			TOM H NEELY TRUST	164	Irr	1/1/19	82				Rio	Hudspeth
906	Cert of Adj		A	RAYMOND R WHETSTONE ET AL	82	Irr	1/1/19	82				Rio	Hudspeth
907	Cert of Adj			LOUIS M FOIX SR	150	Irr	1/1/19	50				Rio	Hudspeth
908	Cert of Adj			LESTER RAY TALLEY JR ET AL	138	Irr	1/1/19	46				Rio	Hudspeth
909	Cert of Adj			LESTER RAY TALLEY JR ET AL	144	Irr	1/1/19	48				Rio	Hudspeth
910	Cert of Adj			MAX R HAMPTON	126	Irr	1/1/19	42				Rio	Hudspeth
911	Cert of Adj			LESTER RAY TALLEY	216	Irr	1/1/19	72				Rio	Hudspeth
912	Cert of Adj			HS TEJAS LTD	15	Irr	1/1/19					Rio	Hudspeth
912	Cert of Adj			HS TEJAS LTD	162	Irr	1/1/19	59				Rio	Hudspeth
913	Cert of Adj			GLORIA GUERRA ADDINGTON	582	Irr	1/1/19	194				Rio	Hudspeth
914	Cert of Adj		A	TEXAS PARKS & WILDLIFE DEPT	219	Irr	1/1/19	73				Rio	Hudspeth
914	Cert of Adj		A	TEXAS PARKS & WILDLIFE DEPT		Other	1/1/19					Rio	Hudspeth
915	Cert of Adj		A	JOHN BUFORD MEADOWS	291.	Irr	1/1/19	552.7				Rio	Presidio
915	Cert of Adj		A	OSCAR B JACKSON	291.	Irr	1/1/19	552.7				Rio	Presidio
915	Cert of Adj		A	MARTIN KENNEDY	291.	Irr	1/1/19	552.7				Rio	Presidio
915	Cert of Adj		A	KENNETH R MATHEWS	291.	Irr	1/1/19	552.7				Rio	Presidio
915	Cert of Adj		A	HARRY MILLER	291.	Irr	1/1/19	552.7				Rio	Presidio
915	Cert of Adj		A	ANDREW H JACKSON	194.	Irr	1/1/19	368.4				Rio	Presidio
915	Cert of Adj		A	C B FIELDS	291.	Irr	1/1/19	552.7				Rio	Presidio
916	Cert of Adj			TEXAS PARKS & WILDLIFE DEPT	714	Irr	1/1/19	476			LOS PALOMAS WLMA	Rio	Presidio
917	Cert of Adj			BILL SHANNON	405	Irr	11/11/19	135				Rio	Presidio
918	Cert of Adj			BILLY O WALKER ET UX	29.1	Irr	1/1/19	9.73				Rio	Presidio
918	Cert of Adj			B J BISHOP	18.8	Irr	1/1/19	6.27				Rio	Presidio
919	Cert of Adj			JAVIER R MOLINA ET UX	243	Irr	1/1/19	81				Rio	Presidio
920	Cert of Adj		B	GORDON LEE JONES ET UX	475.7	Irr	3/20/19	158.5				Rio	Presidio
920	Cert of Adj		B	FERNWOOD ENTERPRISES	19.2	Irr	3/20/19	6.41				Rio	Presidio
921	Cert of Adj			AC&L ARMENDARIZ PARTNERSHIP	270	Irr	1/1/19	90				Rio	Presidio
922	Cert of Adj			MERCED O GARCIA ET AL	90	Irr	1/1/19	30				Rio	Presidio
923	Cert of Adj			ROBERT L SOZA ET AL	120	Irr	3/20/19	40				Rio	Presidio
924	Cert of Adj			WILLIAM SOZA	54	Irr	3/20/19	18				Rio	Presidio
925	Cert of Adj			ERNESTINA CHAVEZ ET AL	42	Irr	3/26/19	14				Rio	Presidio
926	Cert of Adj			ROBERT L SOZA	66	Irr	3/26/19	22				Rio	Presidio
927	Cert of Adj			LAJITAS CAPITAL PARTNERS LLC	72	Irr	3/26/19	24				Rio	Presidio
928	Cert of Adj			LAJITAS CAPITAL PARTNERS LLC	57	Irr	3/26/19	19				Rio	Presidio
929	Cert of Adj			ALFREDO S BAEZA	48	Irr	3/26/19	16				Rio	Presidio
930	Cert of Adj			SOZA & COMPANY	114	Irr	3/26/19	38				Rio	Presidio
931	Cert of Adj		A	ROBERTO R SPENCER ET AL	111	Irr	3/26/19	37				Rio	Presidio
932	Cert of Adj		A	FRANK ARMENDARIZ ET UX	606	Irr	3/26/19	203				Rio	Presidio

APPENDIX 3A. (Continued) AUTHORIZED SURFACE WATER RIGHTS

Water Right	Water Right	Applica-tion	Amend-ment	Owner	Diversion	Use	Priority Date	Acreage	Reservoir Name	Reservoir C	Site Name	Basin	County
933	Cert of Adj			LUZ S ARMENDARIZ	321	Irr	3/26/19	107				Rio	Presidio
936	Cert of Adj			JOSE N RODRIGUEZ	113.8	Irr	3/26/19	38				Rio	Presidio
936	Cert of Adj			JOSE N RODRIGUEZ	33.99	Irr	1/1/19					Rio	Presidio
936	Cert of Adj			SALVADOR RODRIGUEZ SR	33.16	Irr	1/1/19					Rio	Presidio
936	Cert of Adj			SALVADOR RODRIGUEZ SR	111.0	Irr	3/26/19	37				Rio	Presidio
937	Cert of Adj			JOSE A RODRIGUEZ	114	Irr	3/26/19	38				Rio	Presidio
938	Cert of Adj			JOSE A RODRIGUEZ	120	Irr	3/26/19	30				Rio	Presidio
939	Cert of Adj		B	LORENZO HERNANDEZ	45	Irr	3/26/19	15				Rio	Presidio
939	Cert of Adj		B	LORENZO HERNANDEZ	45	Irr	3/26/19					Rio	Presidio
940	Cert of Adj		A	JESUS M RODRIGUEZ JR	180	Irr	1/1/19	42.7				Rio	Presidio
941	Cert of Adj		A	RCS INC	164	Irr	3/26/19	41				Rio	Presidio
942	Cert of Adj			PAULINE JUAREZ CROSSON	25.9	Irr	1/1/19	5.43				Rio	Presidio
942	Cert of Adj			RCS INC	145.3	Irr	1/1/19	30.3				Rio	Presidio
942	Cert of Adj			EDMUNDO SANCHEZ	28.7	Irr	1/1/19	6				Rio	Presidio
943	Cert of Adj			RCS INC	420	Irr	1/1/19	105				Rio	Presidio
944	Cert of Adj		A	SANTA CRUZ LAND & CATTLE INC	743	Irr	2/12/19	231.4				Rio	Presidio
946	Cert of Adj			RCS INC	61	Irr	2/12/19	16				Rio	Presidio
947	Cert of Adj			RCS INC	800	Irr	2/12/19	202				Rio	Presidio
948	Cert of Adj			C & L COMPANY	880	Irr	2/12/19	220				Rio	Presidio
949	Cert of Adj			C & L COMPANY	267	Irr	12/12/19	89				Rio	Presidio
950	Cert of Adj			OSCAR M SPENCER	39	Irr	2/12/19	13				Rio	Presidio
953	Cert of Adj			CF&L ENTERPRISES	407	Irr	2/12/19	136				Rio	Presidio
954	Cert of Adj			CF&L ENTERPRISES	684	Irr	2/12/19	171				Rio	Presidio
955	Cert of Adj			CF&L ENTERPRISES	172	Irr	2/12/19	43				Rio	Presidio
956	Cert of Adj			MANUEL M RUBIO ET AL	84	Irr	1/1/19	21				Rio	Presidio
957	Cert of Adj			EVA MARIA NIETO ET AL	536	Irr	1/1/19	134				Rio	Presidio
958	Cert of Adj			ESBEN CARRASCO	48.2	Irr	1/1/19	12.0				Rio	Presidio
958	Cert of Adj			MANUEL COVOS ET UX	43.7	Irr	1/1/19	10.9				Rio	Presidio
960	Cert of Adj			LAURENCIO BRITO	140	Irr	1/1/19	35				Rio	Presidio
961	Cert of Adj			LAURENCIO BRITO	72	Irr	1/1/19	18				Rio	Presidio
962	Cert of Adj			REYNALDO HERNANDEZ	96	Irr	1/1/19	24				Rio	Presidio
963	Cert of Adj			RCS INC	160	Irr	1/1/19	40				Rio	Presidio
964	Cert of Adj			RCS INC	376	Irr	1/1/19	94				Rio	Presidio
965	Cert of Adj			GEORGE & CONSUELO HERNANDEZ	60	Irr	1/1/19	15				Rio	Presidio
966	Cert of Adj			HECTOR A HERNANDEZ	80	Irr	1/1/19	20				Rio	Presidio
967	Cert of Adj		A	HERMINIA M MCCALL	80	Irr	1/1/19	20				Rio	Presidio
967	Cert of Adj		A	HERMINIA M MCCALL ET AL	180	Irr	1/1/19	45				Rio	Presidio
969	Cert of Adj			JOHN T MACGUIRE ET UX		Rec	10/13/19		SAN ESTEBAN DAM & LAKE	1870		Rio	Presidio
971	Cert of Adj			WILLIAM M WEATHERS ET UX	35	Irr	1/1/19	50				Rio	Presidio
972	Cert of Adj			LUCIA H RUSSELL ESTATE	80	Irr	10/13/19	40				Rio	Presidio
973	Cert of Adj			JOSE A HERNANDEZ	96	Irr	1/1/19	24				Rio	Presidio
974	Cert of Adj		A	PRESIDIO CO WID 1	2780	Irr	1/1/19	700				Rio	Presidio
975	Cert of Adj			LAJITAS CAPITAL PARTNERS LLC	380	Irr	1/1/19	95				Rio	Presidio
976	Cert of Adj			RUBEN H MADRID	56	Irr	1/1/19	14				Rio	Presidio
977	Cert of Adj			LYDIA MADRID	40	Irr	1/1/19	10				Rio	Presidio
978	Cert of Adj		A	MARGARITA C MADRID ET AL	32	Irr	1/1/19	8				Rio	Presidio
978	Cert of Adj		A	MARGARITA C MADRID ET AL	304	Irr	8/12/19	76				Rio	Presidio
979	Cert of Adj		A	JOSEPH TRAVIS TUCKER JR	52	Irr	1/1/19	13				Rio	Presidio
980	Cert of Adj			JOSEPH TRAVIS TUCKER JR	52	Irr	1/1/19	13				Rio	Presidio
981	Cert of Adj			NADINE PINEDA MATA	84	Irr	1/1/19	21				Rio	Presidio
981	Cert of Adj			LEO N PINEDA	84	Irr	1/1/19	21				Rio	Presidio

APPENDIX 3A. (Continued) AUTHORIZED SURFACE WATER RIGHTS

Water Right	Water Right	Applica-tion	Amend-ment	Owner	Diversion	Use	Priority Date	Acreage	Reservoir Name	Reservoir C	Site Name	Basin	County
982	Cert of Adj			JAIME REDE MADRID ET AL	80	Irr	1/1/19	20				Rio	Presidio
983	Cert of Adj		A	THOMAS A MALLAN	84	Irr	1/1/19	21				Rio	Presidio
985	Cert of Adj		A	A G RIMER ET UX	20	Irr	1/1/19	12				Rio	Presidio
986	Cert of Adj		C	LAJITAS CAPITAL PARTNERS LLC	224.2	Irr	3/26/19	71.76				Rio	Brewster
986	Cert of Adj		B	LAJITAS MUNICIPAL SERVICES CO LLC	144	Mun	3/26/19					Rio	Brewster
986	Cert of Adj		B	FRANK W HOWARD	0.74	Irr	3/26/19	0.23				Rio	Brewster
987	Cert of Adj		A	US NATIONAL PARK SVC/US DEPT OF	530	Mun	11/17/19				BIG BEND NATIONAL PARK.US DEPT	Rio	Brewster
987	Cert of Adj		A	US NATIONAL PARK SVC/US DEPT OF	1000	Irr	11/17/19	227			U S DEPT OF THE INTERIOR	Rio	Brewster
988	Cert of Adj			EL CARMEN LAND & CONSERVATION CO LLC	20	Irr	1/1/193	5				Rio	Brewster
989	Cert of Adj			EL CARMEN LAND & CONSERVATION CO LLC	180	Irr	1/1/19	45				Rio	Brewster
990	Cert of Adj			SUSAN COMBS ET AL	1520	Irr	7/2/19	507			COMBS MARAVILLAS RANCHES	Rio	Brewster
991	Cert of Adj			W N CHRIS JORDAN	3800	Irr	7/2/19	1266.				Rio	Brewster
991	Cert of Adj			E A BASSE III	3800	Irr	7/2/19	1266.				Rio	Brewster
992	Cert of Adj			BYRON HODGE ET AL	152	Irr	1/1/19	38				Rio	Terrell
117	Cert of Adj			SCOTT LOCKE MCIVOR	15	Irr	4/1/19	10		20		Rio	Jeff Davis
117	Cert of Adj			SCOTT LOCKE MCIVOR		Rec	4/1/19					Rio	Jeff Davis
117	Cert of Adj			RUTH JOHNSON	69	Irr	1/1/19	69				Rio	Jeff Davis
117	Cert of Adj			H E SPROUL	224	Irr	1/1/19	112		3		Rio	Jeff Davis
117	Cert of Adj			H E SPROUL		Rec	1/1/19					Rio	Jeff Davis
117	Cert of Adj			ISABEL CECILIA THOMPSON	5	Irr	1/1/19	20				Rio	Jeff Davis
117	Cert of Adj			JIMMY G & BESSIE J HIGGINS	4	Irr	1/1/19	2				Rio	Jeff Davis
117	Cert of Adj			GEORGE A HOFFMAN MD ET AL	50	Irr	11/4/19	25				Rio	Jeff Davis
117	Cert of Adj			ESTELLE LANGHAM SHARP	15	Irr	1/1/37	14				Rio	Jeff Davis
139	App/Perm	149		U S BUREAU OF RECLAM	1800	Irr	6/18/19	0			BUREAU OF RECLAMATION	Rio	Jeff Davis
292	Claim			LEONCITA LAND COMPANY		Irr	8/28/19	150		900		Rio	Brewster
300	App/Perm	324		JOE RUSSELL BROWN	312	Irr	6/15/19	104				Rio	Hudspeth
300	App/Perm	324		JOE RUSSELL BROWN	156	Irr	7/15/19	52				Rio	Hudspeth
300	App/Perm	325		DANIEL T ESTRADA	108	Irr	8/12/19	27				Rio	Presidio
300	App/Perm	325		LAJITAS RESORT LTD	132	Irr	8/12/19	33				Rio	Presidio
303	App/Perm	329		POPE RANCH	140.	Irr	11/4/19	132				Rio	Brewster
303	App/Perm	329		POPE RANCHES LP	1119.	Irr	11/4/19	105				Rio	Brewster
303	App/Perm	332	A	SUSAN COMBS ET AL	80	Irr	12/16/19	40	SUMP HOLE AT THE CONFLUENCE OF	10	COMBS MARAVILLAS RANCHES	Rio	Brewster
303	App/Perm	332	A	SUSAN COMBS ET AL	20	Rec	12/16/19				COMBS MARAVILLAS RANCHES	Rio	Brewster
303	App/Perm	332	A	SUSAN COMBS ET AL		Irr	12/16/19				COMBS MARAVILLAS RANCHES	Rio	Brewster
303	App/Perm	332		SUSAN COMBS ET AL	450	Irr	12/16/19	400			COMBS MARAVILLAS RANCHES	Rio	Brewster
304	App/Perm	331	A	TEXAS PARKS & WILDLIFE DEPT	1017	Irr	12/9/19	339				Rio	Hudspeth
304	App/Perm	331	A	TEXAS PARKS & WILDLIFE DEPT		Other	12/9/19					Rio	Hudspeth
309	App/Perm	339		LUCIA H RUSSELL ESTATE	100	Irr	1/12/19	100				Rio	Presidio
311	App/Perm	339		TEXAS PARKS & WILDLIFE DEPT	156	Irr	2/10/19	39				Rio	Presidio
311	App/Perm	340		WALTER TRAVIS POTTER	200	Irr	2/24/19	224				Rio	Brewster
313	App/Perm	336	A	NEVILLE RANCH	18	Irr	6/24/19	9				Rio	Brewster
313	App/Perm	336	A	ELINOR FRANCES GREEN	162	Irr	1/20/19	60		9		Rio	Brewster
314	App/Perm	340		JACKSON B LOVE JR	400	Irr	3/3/19	200				Rio	Brewster
315	App/Perm	340		J FRANK WOODWARD JR	12.5	Irr	3/3/19	20				Rio	Brewster
537	App/Perm	537		BREWSTER COUNTY		Rec	8/16/19			7		Rio	Brewster
543	Cert of Adj			CITY OF BALMORHEA	644	Mun	1/29/19			109		Rio	Jeff Davis
544	Cert of Adj			JAMES P ESPY JR ET AL	45	Irr	12/31/19	12	2 1-AF RESERVOIRS	2		Rio	Jeff Davis
545	Cert of Adj			MISSOURI PACIFIC RAILROAD		Stor	6/16/19		LEVINSON RES	597		Rio	Culberson
545	Cert of Adj			MISSOURI PACIFIC RAILROAD		Stor	7/25/19		LEVINSON RES	327		Rio	Culberson
545	Cert of Adj			J L DAVIS	223	Irr	7/25/19	112				Rio	Culberson

APPENDIX 3A. (Continued) AUTHORIZED SURFACE WATER RIGHTS

Water Right	Water Right	Applica-tion	Amend-ment	Owner	Diversion	Use	Priority Date	Acreage	Reservoir Name	Reservoir	Site Name	Basin	County
545	Cert of Adj			BARRY A BEAL	50	Irr	11/13/19	50		2		Rio	Jeff Davis
546	Cert of Adj			ESTATE OF JOE B CHANDLER ET AL	140	Irr	2/17/19	76	2 RES; 8 AF & 6 AF	14		Rio	Terrell
546	Cert of Adj			THE NATURE CONSERVANCY	530	Irr	12/31/19	137	3 RESERVOIRS	192		Rio	Terrell
546	Cert of Adj		B	WILSON HARDIN "CY" BANNER	150	Irr	12/31/19	49.8				Rio	Terrell
546	Cert of Adj			JOHN EDWARD ROBBINS	8.25	Irr	7/12/19	12				Rio	Terrell
546	Cert of Adj			JOHN CLARK		Irr	7/12/19					Rio	Terrell
546	Cert of Adj			WILSON HARDIN "CY" BANNER	44.4	Irr	12/31/19	16.9		15		Rio	Terrell
546	Cert of Adj			MATTIE BANNER BELL	0.6	Irr	12/31/19	0.23				Rio	Terrell
546	Cert of Adj			C L RANCH PARTNERSHIP	2200	Irr	9/15/19	160		775		Rio	Hudspeth
546	Cert of Adj			CONNECTICUT MUTUAL LIFE INS CO		Irr	9/15/19					Rio	Hudspeth
546	Cert of Adj			JAMES & MARY LYNCH JR		Irr	9/15/19					Rio	Hudspeth
546	Cert of Adj			C L MACHINERY CO ET AL	2400	Irr	9/15/19	180		458		Rio	Hudspeth
546	Cert of Adj			CONNECTICUT MUTUAL LIFE INS CO		Irr	9/15/19					Rio	Hudspeth
546	Cert of Adj			C L RANCH PARTNERSHIP	2100	Irr	9/15/19	898.		588		Rio	Hudspeth
594	Cert of Adj			UNITED STATES OF AMERICA	3760	Mun	7/6/18		ELEPHANT BUTTE RES & CABALLO RES	26388	MESILLA, AMERICAN, RIVERSIDE	Rio	El Paso
594	Cert of Adj			UNITED STATES OF AMERICA		Ind	7/6/18		ELEPHANT BUTTE RES & CABALLO RES		MESILLA, AMERICAN, RIVERSIDE	Rio	El Paso
594	Cert of Adj			UNITED STATES OF AMERICA		Irr	7/6/18	6901	ELEPHANT BUTTE RES & CABALLO RES		MESILLA, AMERICAN, RIVERSIDE	Rio	El Paso
594	Cert of Adj			UNITED STATES OF AMERICA		Min	7/6/18		ELEPHANT BUTTE RES & CABALLO RES		MESILLA, AMERICAN, RIVERSIDE	Rio	El Paso
594	Cert of Adj			UNITED STATES OF AMERICA		Rec	7/6/18		ELEPHANT BUTTE RES & CABALLO RES		MESILLA, AMERICAN, RIVERSIDE	Rio	El Paso
594	Cert of Adj			EL PASO CO WID 1		Mun	7/6/18		ELEPHANT BUTTE RES & CABALLO RES		MESILLA, AMERICAN, RIVERSIDE	Rio	El Paso
594	Cert of Adj			EL PASO CO WID 1		Ind	7/6/18		ELEPHANT BUTTE RES & CABALLO RES		MESILLA, AMERICAN, RIVERSIDE	Rio	El Paso
594	Cert of Adj			EL PASO CO WID 1		Irr	7/6/18		ELEPHANT BUTTE RES & CABALLO RES		MESILLA, AMERICAN, RIVERSIDE	Rio	El Paso
594	Cert of Adj			EL PASO CO WID 1		Min	7/6/18		ELEPHANT BUTTE RES & CABALLO RES		MESILLA, AMERICAN, RIVERSIDE	Rio	El Paso
594	Cert of Adj			EL PASO CO WID 1		Rec	7/6/18		ELEPHANT BUTTE RES & CABALLO RES		MESILLA, AMERICAN, RIVERSIDE	Rio	El Paso
594	Cert of Adj			CEMEX EL PASO INC	178	Ind	1/1/19		CEMENT LAKE	178		Rio	El Paso
594	Cert of Adj			CITY OF EL PASO	1100	Mun	11/1/19					Rio	El Paso
594	Cert of Adj			INDIAN CLIFFS RANCH INC		Rec	10/11/19			52		Rio	El Paso
594	Cert of Adj		A	UNITED STATES OF AMERICA	2660	Irr	11/22/19	900				Rio	El Paso
594	Cert of Adj		A	HUDSPETH COUNTY CRD 1		Irr	11/22/19					Rio	El Paso
594	Cert of Adj		A	HUDSPETH COUNTY CRD 1		Ind	11/22/19					Rio	El Paso
594	Cert of Adj		A	HUDSPETH COUNTY CRD 1		Min	11/22/19					Rio	El Paso
594	Cert of Adj		A	HUDSPETH COUNTY CRD 1		Rec	11/22/19					Rio	El Paso

CHAPTER 4
IDENTIFICATION OF WATER NEEDS

This page intentionally left blank.

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 (Table 2-2) with water supplies available to meet those demands from Chapter 3 (Table 3-2). 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 needs/surpluses analysis for all wholesale water providers within the Far West Texas Region.

Water supply deficits are identified for a number of municipalities, manufacturing use and steam power electric generation in El Paso County; for irrigation supply use in Culberson, El Paso, and Hudspeth Counties, and for mining supply in Culberson, El Paso, Hudspeth and Terrell Counties.

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 is provided in Table 4-3. 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 4-4 presents unmet needs resulting from insufficient supplies to meet certain strategies.

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 Chapter 6, Appendix 6A.

Table 4-1. Identified Water (Needs)/Surpluses
(Acre Feet per Year)

	2020	2030	2040	2050	2060	2070
Brewster County						
Alpine	231	222	230	232	229	226
County-Other	503	483	482	478	475	472
Manufacturing	0	0	0	0	0	0
Livestock	0	0	0	0	0	0
Irrigation	968	979	992	1,003	1,014	1,025
Brewster County Total Needs/Surplus	1,702	1,684	1,704	1,713	1,718	1,723
Culberson County						
Van Horn	689	640	614	590	576	567
County-Other	75	70	69	67	66	65
Mining	(291)	(1,025)	(1,178)	(895)	(628)	(425)
Livestock	0	0	0	0	0	0
Irrigation	57	911	1,747	2,565	3,366	4,150
Culberson County Total Needs/Surplus	530	596	1,252	2,327	3,380	4,357
El Paso County						
Anthony	468	350	237	119	1	(111)
Clint	184	188	192	193	193	193
El Paso	20,427	10,685	1,287	(8,978)	(19,602)	(29,792)
El Paso County Tornillo WID	205	212	217	220	220	219
El Paso WCID #4	254	272	284	282	266	248
Fort Bliss	(26)	(40)	(74)	(128)	(178)	(228)
Horizon City	(1,352)	(3,203)	(4,941)	(6,669)	(8,308)	(9,853)
Horizon Regional MUD	(1,233)	(2,582)	(3,851)	(5,115)	(6,317)	(7,451)
Lower Valley WD	(2,453)	(3,228)	(3,965)	(4,734)	(5,500)	(6,227)
Socorro	(217)	(488)	(757)	(1,069)	(1,406)	(1,732)
Vinton	152	146	140	133	125	117
County-Other	(368)	(764)	(1,220)	(1,754)	(2,259)	(2,745)
Manufacturing	(8,841)	(9,968)	(11,058)	(11,985)	(13,461)	(15,050)
Mining	1,698	1,080	444	(242)	(987)	(1,833)
Steam Electric Power	(3,651)	(4,825)	(6,255)	(7,998)	(10,124)	(12,651)
Livestock	0	0	0	0	0	0
Irrigation	(75,165)	(71,278)	(60,950)	(55,026)	(50,512)	(46,834)
El Paso County Total Needs/Surplus	(69,918)	(84,523)	(90,162)	(102,751)	(117,849)	(133,730)
Hudspeth County						
Sierra Blanca	691	680	677	675	674	673
County-Other	569	551	553	552	550	548
Manufacturing	8	8	8	8	8	8
Mining	2	30	13	(2)	(11)	(21)
Livestock	0	0	0	0	0	0
Irrigation	(94,847)	(91,139)	(87,508)	(83,952)	(80,470)	(77,060)
Hudspeth County Total Needs/Surplus	(93,577)	(89,870)	(86,257)	(82,719)	(79,249)	(75,852)
Jeff Davis County						
Fort Davis	46	51	55	57	58	58
County-Other	504	509	514	516	517	517
Livestock	0	0	0	0	0	0
Irrigation	797	810	823	836	853	867
Jeff Davis County Total Needs/Surplus	1,347	1,370	1,392	1,409	1,428	1,442

Table 4-1. (Continued) Identified Water (Needs)/Surpluses
(Acre Feet per Year)

Presidio County						
Marfa	1,185	1,147	1,107	1,056	1,010	966
Presidio	2,930	2,900	2,868	2,825	2,781	2,738
County-Other	339	321	301	275	250	227
Mining	0	403	403	403	403	403
Livestock	0	0	0	0	0	0
Irrigation	4,371	4,462	4,551	4,638	4,723	4,804
Presidio County Total Needs/Surplus	8,825	9,233	9,230	9,197	9,167	9,138
Terrell County						
Sanderson	325	325	327	328	328	328
County-Other	42	42	42	42	42	42
Mining	(449)	(552)	(516)	(382)	(259)	(161)
Livestock	0	0	0	0	0	0
Irrigation	712	722	732	737	747	754
Terrell County Total Needs/Surplus	630	537	585	725	858	963
Region E Total Needs/Surplus	**(155,784)**	**(159,813)**	**(162,256)**	**(170,099)**	**(180,547)**	**(191,959)**

Note: ( ) Indicates an identified water need.

Table 4-2. Far West Texas Wholesale Water Provider (Needs)/Surpluses
(Acre-Feet per Year)

El Paso County WID#1	Total Supply	167,633	169,570	171,430	173,553	174,328	174,328
	Total Demand	291,418	293,850	289,713	290,612	291,967	293,358
	Surplus / (Need)	**(123,785)**	**(124,280)**	**(118,283)**	**(117,059)**	**(117,639)**	**(119,030)**
El Paso Water Utilities	Total Supply	131,000	131,000	131,000	131,000	131,000	131,000
	Total Demand	147,334	160,611	173,737	187,980	203,416	218,776
	Surplus / (Need)	**(16,334)**	**(29,611)**	**(42,737)**	**(56,980)**	**(72,416)**	**(87,776)**
Lower Valley Water District	Total Supply	4,356	4,356	4,356	4,356	4,356	4,356
	Total Demand	6,842	7,884	8,886	9,966	11,069	12,122
	Surplus / (Need)	**(2,486)**	**(3,528)**	**(4,530)**	**(5,610)**	**(6,713)**	**(7,766)**
Horizon MUD	Total Supply	5,546	5,546	5,546	5,546	5,546	5,546
	Total Demand	8,131	11,331	14,338	17,330	20,171	22,850
	Surplus / (Need)	**(2,585)**	**(5,785)**	**(8,792)**	**(11,784)**	**(14,625)**	**(17,304)**

Table 4-3. Second-Tier Identified Water Needs
(Acre-Feet per Year)

	2020	2030	2040	2050	2060	2070
Brewster County						
Rio Grande Basin						
Alpine	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Manufacturing	0	0	0	0	0	0
Livestock	0	0	0	0	0	0
Irrigation	0	0	0	0	0	0
Culberson County						
Rio Grande Basin						
Van Horn	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Mining	291	1,025	1,178	895	628	425
Livestock	0	0	0	0	0	0
Irrigation	0	0	0	0	0	0
El Paso County						
Rio Grande Basin						
Anthony	0	0	0	0	0	104
Clint	0	0	0	0	0	0
El Paso	0	0	0	0	0	0
El Paso County Tornillo WID	0	0	0	0	0	0
El Paso WCID #4	0	0	0	0	0	0
Fort Bliss	0	0	0	0	32	81
Horizon City	1,307	3,140	4,861	6,571	8,194	9,723
Horizon Regional MUD	1,196	2,532	3,788	5,039	6,229	7,352
Lower Valley WD	2,417	3,185	3,914	4,675	5,434	6,154
Socorro	185	454	720	1,029	1,362	1,685
Vinton	0	0	0	0	0	0
County-Other	368	755	1,212	1,746	2,251	2,738
Manufacturing	8,841	9,968	11,058	11,985	13,461	15,050
Mining	0	0	0	242	987	1,833
Steam Electric Power	3,651	4,825	6,255	7,998	10,124	12,651
Livestock	0	0	0	0	0	0
Irrigation	46,702	42,815	32,487	26,563	22,049	18,371
Hudspeth County						
Rio Grande Basin						
Sierra Blanca	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	2	11	21
Livestock	0	0	0	0	0	0
Irrigation	90,723	87,015	83,384	79,828	76,346	72,936

Table 4-3. (Continued) Second-Tier Identified Water Needs
(Acre-Feet per Year)

	2020	2030	2040	2050	2060	2070
Jeff Davis County						
Rio Grande Basin						
Fort Davis	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Livestock	0	0	0	0	0	0
Irrigation	0	0	0	0	0	0
Presidio County						
Rio Grande Basin						
Marfa	0	0	0	0	0	0
Presidio	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	0	0	0	0	0	0
Terrell County						
Rio Grande Basin						
Sanderson	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Mining	449	552	516	382	259	161
Livestock	0	0	0	0	0	0
Irrigation	0	0	0	0	0	0

Table 4-4. WUG Unmet Needs
(Acre-Feet per Year)

	2020	2030	2040	2050	2060	2070
Culberson County						
Rio Grande Basin						
Irrigation	0	0	0	3,435	2,634	1,850
El Paso County						
Rio Grande Basin						
Irrigation	53,202	49,315	38,987	33,063	28,549	24,871
Hudspeth County						
Rio Grande Basin						
Irrigation	90,493	86,785	83,154	83,598	80,116	76,706
Terrell County						
Rio Grande Basin						
Mining	449	552	516	382	259	161

This page intentionally left blank.

CHAPTER 5

WATER MANAGEMENT STRATEGIES AND CONSERVATION RECOMMENDATIONS

This page intentionally left blank.

5 WATER MANAGEMENT STRATEGIES AND CONSERVATION RECOMMENDATIONS

The Far West Texas Regional Water Planning Group has identified and evaluated a total of 64 water management strategies. Of this total, 64 strategies have been recommended and one alternate strategy, which is a supply volume variation of one of the recommended strategies, was evaluated for the *2016 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. 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.

5.1 IDENTIFICATION OF POTENTIALLY FEASIBLE WATER MANAGEMENT STRATEGIES

5.1.1 Selection Process

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 Texas Water Code §16.053(d)(5), the regional water plan shall consider, but not be limited to, the following potentially feasible water management strategies:

- Improved conditions
- Reuse
- Management of existing water supplies
- Conjunctive use
- Acquisition of available existing water supplies
- Development of new water supplies
- Developing regional water supply facilities or providing regional management of water supply facilities
- Voluntary transfer of water within a region using, but not limited to, regional water banks, sales, leases, options, subordination agreements, and financing agreements
- Emergency transfer of water

Other potential projects considered for the initial list included:

- appropriate strategies from the *2011 Plan*
- conservation practices
- 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 Water Planning Group to identify *potentially feasible water management strategies*.

1. Receive a *Needs Analysis Report* (Table 4-1) from the TWDB, which provides a comparison of existing water supplies and projected water demands for each water user group (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. Using the following process, identify and select potentially feasible water management strategies for each of these entities.
2. Review and consider recommended water management strategies adopted by the water planning group for the *2011 Far West Texas 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
   - 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 Water Planning Group selected the initial *potentially feasible water management strategies* listed in Table 5-1for further detailed analysis. 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 insure that the strategies discussion met with their approval. The evaluation and final recommendation of water management strategies are provided in the following Section 5.2.

Table 5-1. Far West Texas Potentially Feasible Water Management Strategies

County	WUG	WMS	Water Management Strategy
Brewster	County Other - Marathon WSS	1	Water loss audit and replace necessary distribution lines
	County Other - Study Butte	2	Replace water distribution lines and install pressure reducing equipment
	County Other - BBNP Rio Grande Village	3	Water loss audit and replace necessary distribution lines
Culberson	Mining	4	Drill additional wells
El Paso	City of Anthony	5	Improve water treatment to include arsenic removal and new storage tank; replacement of distribution lines, meters, and pumps
		6	Provide public with conservation information
	City of El Paso	7	Municipal conservation initiatives
		8	Additional reclaimed potable water from Haskell/NW Plant
		9	Advanced purified water treatment expansion at Bustamante Plant
		10	Recharge of Hueco groundwater with treated surface water from Jonathan Rogers Plant
		11	Desalination of agricultural drain water
		12	Desalination facility at Canal Plant to treat local brackish groundwater
		13	Desalination facility at Jonathan Rogers Plant to treat local brackish groundwater
		14	Expanded supply from KBH desalination facility
		15	New groundwater supply from wells in western Diablo Plateau
		16	New groundwater supply from wells in lower valley area of Hudspeth County
		17	Expansion of treatment capacity at Jonathan Rogers Plant
		18	EPWU / EPCWID1 stormwater conservation storage facility
		19	Imported groundwater from Dell Valley
		20	Imported groundwater from Diablo Farms
	Lower Valley Water District	21	Purchase water from EPWU
		22	Provide public with conservation information
	City of Socorro	23	Purchase water from LVWD
	Horizon City	24	Purchase water from Horizon MUD
	Horizon Regional MUD	25	Additional wells and desalination plant expansion
		26	Provide public with conservation information
	Fort Bliss	27	Purchase water from EPWU
	El Paso County Tornillo WID	28	Additional wells
		29	Arsenic treatment facility
	City of Vinton	30	Installation of new high capacity water lines for improved water distribution from EPWU
	El Paso County Other	31	Purchase water from EPWU
	Manufacturing	32	Purchase water from EPWU
	Mining	33	Drill additional wells
	Steam Electric Power	34	Purchase water from EPWU
	Irrigation (EPCWID#1)	35	Irrigation scheduling (Conservation)
		36	Tailwater reuse
		37	Water district delivery systems (Conservation)
Hudspeth	City of Sierra Blanca - Hudspeth Co. WCID#1	38	Additional storage facilities
	County Other - Del City	39	Water loss audit and replace necessary distribution lines
		40	Install new reverse osmosis water treatment facility
	County Other - Fort Hancock WCID	41	Water loss audit and replace necessary distribution lines
	Mining	42	Drill additional wells
	Irrigation (HCUWCD#1)	43	Irrigation scheduling (Conservation)
		44	Tailwater reuse
	Irrigation (HCCRD#1)	45	No feasible strategy
Jeff Davis	Fort Davis WSC	46	Drill additional wells
Presidio	City of Marfa	47	Drill additional wells
Terrell	Mining	48	Drill additional wells

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:

Table 5-2

- Quantity
- Quality
- Reliability
- Impacts to water, agricultural, and natural resources, and to ecologically unique stream segments

Table 5-3

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

Table 5-4

- 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 operating and maintenance (O&M) expenses. Capital costs are estimated based on September 2013 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. 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 insure 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 Water Quality Management Plans (WQMPs) of TCEQ and the Texas State Soil and Water Conservation Board (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 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 Drought Preparedness Council are considered in this *Plan* and consist of four activities: (1) Drought Monitoring; (2) Impact Assessment; (3) Research and Educational Programs; and (4) Drought Mitigation Strategies. Also, WUGs conservation and drought management plans (see Chapters 5 and 7) were reviewed to identify potential strategies that are currently under consideration by the entity.

El Paso Water Utilities' water management strategies (E-7 through E-20) are described as "Integrated Strategies" meaning that the operation of the entire water supply system is not dependent on any one or more individual facilities, but rather draws from each source at a rate that is optimal for the entire system under the existing circumstances. Although the strategy facilities will work together to provide necessary supplies, each strategy is independent of the others and does not rely on or mutually exclude any other strategy. All other strategies in this *Plan* likewise do not rely on or mutually exclude any other strategies.

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 undertaken either voluntarily by water customers or as mandated by a water suppliers. Conservation savings are the result of "active" water conservation strategies that conserve water over and beyond what would happen anyway as a result of "passive" water conservation measures that stem from federal and state legislation requiring more efficient plumbing fixtures in new building construction. Existing WUG conservation and drought management plans were reviewed, and conservation strategies selected for this *Plan* were often identified from these plans.

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 requires 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 (see further discussion in Chapter 1 Section 1.9). Entities reporting more than a 10 percent water loss were selected to receive a water-loss audit and line replacement strategy.

Reuse of treated wastewater is also an excellent strategy for producing additional water supplies from existing developed sources, or for use in areas where drinking water is not required such as irrigation. Reuse strategies were particularly considered for the El Paso Water Utilities.

5.2.3 Recommended Water Management Strategies

To adequately consider the unique challenges faced by municipal and industrial water users in El Paso County, a conjunctive approach was used to establish feasible strategies capable of identifying sufficient future supplies to meet the needs of El Paso Water Utilities, the largest wholesale water provider in the county.

The evaluation of irrigation strategies for El Paso and Hudspeth Counties differs slightly in that these strategies consider recommended management practices and are discussed in detail in a regional planning study titled *Evaluation of Irrigation Efficiency Strategies for Far West Texas: Feasibility, Water Savings and Cost Considerations (2009)*.

Table 5-2 provides a comparative listing of all water management strategies that the FWTWPG subsequently recommends in total for inclusion in the *2016 Far West Texas Water Plan*. Table 5-3 provides a breakdown of the cost estimate for each strategy, and Table 5-4 shows potential impacts of enacting each strategy. Strategy evaluations are presented in Appendix 5A at the end of this chapter. The total capital cost for development of the 64 water management strategies is $1,903,771,872.

5.2.4 Alternate Water Management Strategies

Upon conclusion of a thorough evaluation process, the FWTWPG identified one “alternate” water management strategy for Terrell County Mining. This specific strategy could not be listed as “recommended” because the supply generated by the strategy was in excess of the source supply available based on MAG determination. “Alternate” water management strategies must be 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. The total capital cost for development of the “alternate” water management strategy for Terrell County Mining is $738,000.

5.2.5 Unmet Needs

Sufficient water management strategy supplies are recommended to meet the identified projected needs of all water user groups (WUGs) in the Region except for irrigation categories in El Paso and Hudspeth Counties. Both the El Paso County WID#1 and the Hudspeth County CRD#1 depend on flows in the Rio Grande as their primary irrigation supply source, and during drought-of-record conditions this source is significantly diminished or nonexistent. There are no other supply sources that can be tapped to make up the total needed volume of supply when the Rio Grande is at this stage. However, the following conservation and groundwater use strategies are developed for these two WUGs that provide a minimal amount of supply relief.

Far West Texas WUG Unmet Needs

	2020	2030	2040	2050	2060	2070
Culberson County Irrigation	0	0	0	3,435	2,634	1,850
El Paso County Irrigation	53,202	49,315	38,987	33,063	28,549	24,871
Hudspeth County Irrigation	90,493	86,785	83,154	83,598	80,116	76,706
Terrell County Mining	449	552	516	382	259	161

Table 5-2. Summary of Recommended and Alternate Water Management Strategy Evaluations
(All strategies are in the Rio Grande River Basin)

County	Water User Group	Strategy	Source	2011 Strategy ID	2016 Strategy ID	Strategy Supply (Acre-Feet/Year)						Total Capital Cost (Table 5-3)	Quantity[1]	Quality[2]	Reliability[3]	Strategy Impacts[4]: Water Resources	Strategy Impacts[4]: Agricultural Resources	Strategy Impacts[4]: Natural Resources	Strategy Impacts[4]: Ecologically Unique Stream Segments
						2020	2030	2040	2050	2060	2070					(1-5)	(1-5)	(1-5)	(1-5)
Brewster	Brewster County Other (Marathon WSSService)	Water loss audit and main-line repair	Conservation		E-1	65	65	65	65	65	65	$426,000	NA	NA	NA	1	2	2	2
	Brewster County Other (Rio Grande Village BBNP)	Water loss audit and main-line repair	Conservation		E-2	6	6	6	6	6	6	$607,000	NA	NA	NA	1	2	2	2
	Brewster County Other (Panther Junction BBNP Plt)	Water loss audit and main-line repair	Conservation		E-3	2	2	2	2	2	2	$759,000	NA	NA	NA	1	2	2	2
Culberson	City of Van Horn	Water loss audit and main-line repair	Conservation		E-4	30	30	30	30	30	30	$1,197,000	NA	NA	NA	1	2	2	2
	*Culberson County Mining	Additional groundwater wells	Rustler Aquifer		E-5	590	590	590	590	590	590	$608,000	2	3	1	2	2	2	2
		Additional groundwater well	West Texas Bolsons Aquifer / Upper Salt Basin		E-6	590	590	590	590	590	590	$675,000	2	3	1	2	2	2	2
El Paso	*Town of Anthony	Water loss audit and main-line repair	Conservation		E-7	7	7	7	7	7	7	$759,000	3	NA	NA	1	2	2	2
		Arsenic treatment facility	Mesilla Bolson Aquifer		E-8	2,800	2,800	2,800	2,800	2,800	2,800	$9,952,000	1	2	1	2	2	2	2
		Additional groundwater well	Hueco-Mesilla Bolson Aquifer		E-9	960	960	960	960	960	960	$1,244,471	1	2	1	2	2	2	2
	*City of El Paso (EPWU)	Municipal conservation programs	Conservation	E-2	E-10	1,870	2,110	1,160	2,550	5,530	5,910	$0	3	NA	NA	1	NA	NA	NA
		Advanced purified water at the Haskell and NW WWTPs	Reuse Treated Wastewater		E-11			3,000	7,500	12,000	16,500	$291,800,000	3	2	1	2	2	2	2
		Advanced purified water at the Bustamante WWTP	Reuse Treated Wastewater		E-12	8,000	9,000	10,000	10,000	10,000	10,000	$94,096,000	3	2	1	2	2	2	2
		Recharge of Hueco Aquifer groundwater with treated surface water from Jonathan Rogers Plant	Rio Grande	E-3	E-13	5,000	5,000	5,000	5,000	5,000	5,000	$2,495,000	3	2	2	1	2	3	2
		Treatment & reuse of agricultural drain water	Agricultural Drain Water	E-4	E-14		2,700	2,700	2,700	2,700	2,700	$41,679,000	3	2	2	2	5	3	2
		Expansion of local well fields	Hueco-Mesilla Bolson Aquifer		E-15	3,880	7,760	11,640	15,520	19,400	23,280	$32,712,000	3	1	1	3	2	2	2
		Brackish Groundwater at the Jonathan Rogers WTP	Rio Grande Alluvium Aquifer		E-16			11,000	11,000	11,000	11,000	$65,865,000	3	2	1	3	2	2	2
		Expansion of the Kay Bailey Hutchison Desal Plant	Hueco Bolson Aquifer		E-17	1,260	2,520	2,520	2,520	2,520	2,520	$37,200,000	3	2	1	2	2	2	2
		Groundwater from Hueco Ranch	Other Aquifer / Diablo Plateau		E-18			5,000	5,000	5,000	5,000	$155,858,000	3	1	1	3	2	2	2
		Groundwater from Southern Hudspeth County	Other Aquifer / Diablo Plateau		E-19	10,000	10,000	10,000	10,000	10,000	10,000	$98,980,000	3	1	1	3	2	2	2
		Expansion of the Jonathan Rogers WTP	Rio Grande		E-20	6,500	6,500	6,500	6,500	6,500	6,500	$95,186,653	3	2	2	2	5	2	2
		Riverside Regulating Reservoir	Rio Grande & Stormwater Run-off		E-21	6,500	6,500	6,500	6,500	6,500	6,500	$20,754,157	3	3	2	2	2	3	2
		Groundwater from Diablo Farms	Capitan Reef Complex Aquifer	E-7	E-22				10,000	10,000	10,000	$273,507,000	3	1	1	2	5	2	2
		Groundwater from Dell City area	Bone Spring-Victorio Peak Aquifer	E-6	E-23					10,000	20,000	$303,185,000	3	2	1	2	5	2	2

Table 5-2. (Continued) Summary of Recommended and Alternate Water Management Strategy Evaluations
(All strategies are in the Rio Grande River Basin)

County	Water User Group	Strategy	Source	2011 Strategy ID	2016 Strategy ID	Strategy Supply (Acre-Feet/Year)						Total Capital Cost (Table 5-3)	Quantity[1]	Quality[2]	Reliability[3]	Strategy Impacts[4] Water Resources	Agricultural Resources	Natural Resources	Ecologically Unique Stream Segments
						2020	2030	2040	2050	2060	2070					(1-5)	(1-5)	(1-5)	(1-5)
El Paso	*Lower Valley Water District	Public conservation education	Conservation		E-24	36	43	51	59	66	73	$0	3	NA	NA	1	NA	NA	NA
		Purchased water from EPWU	EPWU Blended Source	E-10	E-25	2,453	3,228	3,965	4,734	5,500	6,227	$0	1	1	1	2	2	2	2
		Surface water treatment plant & transmission line	Rio Grande		E-26	6,700	6,700	6,700	6,700	6,700	6,700	$34,080,000	1	2	2	2	5	2	2
		Groundwater from proposed Well field	Other Aquifer / Rio Grande Alluvium Aquifer		E-27	6,800	6,800	6,800	6,800	6,800	6,800	$37,490,000	1	2	1	3	2	2	2
		Groundwater from proposed Well field	Hueco Bolson Aquifer		E-28	6,800	6,800	6,800	6,800	6,800	6,800	$41,070,000	1	1	1	3	2	2	2
		Wastewater treatment facility and ASR	Reuse Treated Wastewater		E-29	3,808	3,808	3,808	3,808	3,808	3,808	$18,108,000	2	2	1	1	2	2	2
	*City of Socorro	Public conservation education	Conservation		E-30	32	34	37	40	44	47	$0	3	NA	NA	1	NA	NA	NA
		Purchased water from LVWD	EPWU Blended Source	E-12	E-31	217	488	757	1,069	1,406	1,732	$0	1	1	1	2	2	2	2
	*Horizon City	Public conservation education	Conservation		E-32	45	63	80	98	114	130	$0	3	NA	NA	1	NA	NA	NA
		Purchased water from Horizon Regional MUD	Other Aquifer / Rio Grande Alluvium Aquifer		E-33	1,352	3,203	4,941	6,669	8,308	9,853	$0	1	1	1	2	2	2	2
	*Horizon Regional MUD	Public conservation education	Conservation		E-34	37	50	63	76	88	99	$0	3	NA	NA	1	NA	NA	NA
		Additional wells & expansion of desal plant	Hueco Bolson & Other Aquifer (Rio Grande Alluvium Aquifer)	E-8	E-35	2,585	5,785	8,792	11,784	14,625	17,304	$56,443,000	1	2	1	3	2	2	2
	*Fort Bliss	Public conservation education	Conservation		E-36	16	17	17	18	18	19	$0	3	NA	NA	1	NA	NA	NA
		Purchased water from EPWU	EPWU Blended Source	E-9	E-37				100	100	100	$0	1	1	1	2	2	2	2
	El Paso County Tornillo WID	Additional groundwater well & transmission line	Hueco Bolson Aquifer	E-13	E-38	333	333	333	333	333	333	$1,726,000	NA	1	1	3	2	2	2
		Arsenic treatment facility	Hueco Bolson Aquifer	E-23	E-39	276	276	276	276	276	276	$3,114,000	NA	2	1	1	2	2	2
	City of Vinton	High capacity water lines for improved distribution of water from EPWU	EPWU Blended Source		E-40	400	400	400	400	400	400	$4,192,000	NA	1	1	2	2	2	2
	*El Paso County Other	Public conservation education	Conservation		E-41	0	9	8	8	8	7	$0	NA	NA	NA	1	2	2	2
		Purchased water from EPWU	EPWU Blended Source	E-15	E-42	368	764	1,220	1,754	2,259	2,745	$0	1	1	1	2	2	2	2
	*El Paso County Irrigation (EPCWID #1)	Irrigation scheduling	Rio Grande	E-18	E-43	1,740	1,740	1,740	1,740	1,740	1,740	$0	3	3	2	1	1	2	2
		Tailwater reuse	Rio Grande	E-20	E-44	1,723	1,723	1,723	1,723	1,723	1,723	$0	3	3	2	1	1	2	2
		Improvements to water district delivery system	Rio Grande	E-19	E-45	25,000	25,000	25,000	25,000	25,000	25,000	$157,777,783	3	3	2	1	1	2	2
	*El Paso County Manufacturing	Purchased water from EPWU	EPWU Blended Source	E-16	E-46	8,841	9,968	11,058	11,985	13,461	15,050	$0	1	1	1	2	2	2	2
	*El Paso County Mining	Additional groundwater wells	Hueco-Mesilla Bolson Aquifer		E-47				242	987	1,833	$969,000	1	3	1	3	2	2	2
	*El Paso County Steam Electric Power	Purchased water from EPWU	EPWU Blended Source	E-17	E-48	3,651	4,825	6,255	7,998	10,124	12,651	$0	1	1	1	2	2	2	2

Table 5-2. (Continued) Summary of Recommended and Alternate Water Management Strategy Evaluations
(All strategies are in the Rio Grande River Basin)

County	Water User Group	Strategy	Source	2011 Strategy ID	2016 Strategy ID	Strategy Supply (Acre-Feet/Year)						Total Capital Cost (Table 5-3)	Quantity[1]	Quality[2]	Reliability[3]	Strategy Impacts[4] Water Resources	Agricultural Resources	Natural Resources	Ecologically Unique Stream Segments
						2020	2030	2040	2050	2060	2070					(1-5)	(1-5)	(1-5)	(1-5)
Hudspeth	Hudspeth County Other (Dell City)	Water loss audit and main-line repair	Conservation		E-49	1	1	1	1	1	1	$1,614,000	NA	NA	NA	1	2	2	2
		Brackish groundwater desal facility	Bone Spring-Victorio Peak Aquifer		E-50	111	111	111	111	111	111	$1,299,000	NA	2	1	2	2	2	2
	Hudspeth County Other (Fort Hancock WCID)	Water loss audit and main-line repair	Conservation		E-51	3	3	3	3	3	3	$292,000	NA	NA	NA	1	2	2	2
		Additional well & RO treatment facility	Hueco-Mesilla Bolson Aquifer		E-52	565	565	565	565	565	565	$6,109,000	NA	2	1	3	2	2	2
	Hudspeth County Other (City of Sierra Blanca - Hudspeth Co. WCID #1)	Additional transmission line to supply connections outside of the District	West Texas Bolsons Aquifer / Salt Basin		E-53	351	351	351	351	351	351	$1,429,000	NA	1	1	2	2	2	2
	*Hudspeth Irrigation (HCCRD #1)	Additional groundwater wells	Other Aquifer / Rio Grande Alluvium Aquifer	E-NA	E-54	230	230	230	230	230	230	$173,000	3	3	1	3	1	2	2
	Hudspeth Irrigation (HCUWCD #1)	Irrigation scheduling	Bone Spring-Victorio Peak Aquifer	E-21	E-55	3,535	3,535	3,535	3,535	3,535	3,535	$0	NA	3	2	1	1	2	2
		Tailwater reuse	Bone Spring-Victorio Peak Aquifer	E-22	E-56	589	589	589	589	589	589	$0	NA	3	2	1	1	2	2
	*Hudspeth County Mining	Additional groundwater well	West Texas Bolsons Aquifer / Eagle Flat		E-57	30	30	30	30	30	30	$449,000	1	3	1	3	2	2	2
Jeff Davis	Fort Davis WSC	Additional groundwater well	Igneous Aquifer		E-58	274	274	274	274	274	274	$507,000	NA	1	1	3	2	2	2
		Additional transmission line to connect Fort Davis WSC to Fort Davis Estates	Igneous Aquifer		E-59	114	114	114	114	114	114	$1,068,000	NA	1	1	2	2	2	2
	Jeff Davis County Other (Town of Valentine)	Additional groundwater well	West Texas Bolsons Aquifer / Salt Basin		E-60	65	65	65	65	65	65	$402,808	NA	1	1	3	2	2	2
Presidio	City of Marfa	Additional groundwater well	Igneous Aquifer	E-24	E-61	785	785	785	785	785	785	$1,143,000	NA	1	1	2	2	2	2
	City of Presidio	Water loss audit and main-line repair	Conservation		E-62	9	9	9	9	9	9	$2,172,000	NA	NA	NA	1	2	2	2
		Additional groundwater well	West Texas Bolsons Aquifer / Presidio-Redford		E-63	120	120	120	120	120	120	$1,861,000	NA	1	1	3	2	2	2
Terrell	*Terrell County Mining	Additional groundwater wells	Edwards-Trinity (Plateau) Aquifer		E-64	0	0	0	0	0	0	$738,000	3	3	1	3	2	2	2
					Totals	**128,054**	**145,980**	**177,676**	**206,835**	**238,670**	**268,191**	**1,903,771,872**							

2016 Alternate Water Management Strategy

County	Water User Group	Strategy	Source	2011 Strategy ID	2016 Strategy ID	Strategy Supply (Acre-Feet/Year)						Total Capital Cost (Table 5-3)	Quantity[1]	Quality[2]	Reliability[3]	Strategy Impacts[4] Water Resources	Agricultural Resources	Natural Resources	Ecologically Unique Stream Segments
						2020	2030	2040	2050	2060	2070					(1-5)	(1-5)	(1-5)	(1-5)
Terrell	*Terrell County Mining	Additional groundwater wells	Edwards-Trinity (Plateau) Aquifer		E-64	560	560	560	560	560	560	$738,000	1	3	1	3	2	2	2

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

See Appendix 5B for quantification description of impact ranges.

1 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)*

2 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

3 Reliability Range: 1 = Sustainable; 2 = Interruptible during droughts; 3 = Non-sustainable

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

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

County	Water User Group	Strategy	Strategy ID	Total Capital Cost*	Total Annual Cost						Cost per Acre-Foot/Year					
					2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
Brewster	Brewster County-Other (Marathon WSSService)	Water loss audit and main-line repair	E-1	$426,000	$39,000	$39,000	$3,000	$3,000	$3,000	$3,000	$603	$603	33	$33	$33	$33
	Brewster County-Other (Rio Grande Village BBNP)	Water loss audit and main-line repair	E-2	$607,000	$55,000	$55,000	$3,000	$3,000	$3,000	$3,000	$8,661	$8,661	$476	$476	$476	$476
	Brewster County-Other (Panther Junction BBNP Plt)	Water loss audit and main-line repair	E-3	$759,000	$69,000	$69,000	$5,000	$5,000	$5,000	$5,000	$34,500	$34,500	$1,898	$1,898	$1,898	$1,898
Culberson	City of Van Horn	Water loss audit and main-line repair	E-4	$1,197,000	$107,000	$107,000	$7,000	$7,000	$7,000	$7,000	$3,627	$3,627	$200	$200	$200	$200
	Culberson County Mining	Additional groundwater wells	E-5	$608,000	$88,000	$88,000	$37,000	$37,000	$37,000	$37,000	$149	$149	$64	$64	$64	$64
		Additional groundwater well	E-6	$675,000	$91,000	$91,000	$35,000	$35,000	$35,000	$35,000	$154	$154	$59	$59	$59	$59
El Paso	Town of Anthony	Water loss audit and main-line repair	E-7	$759,000	$69,000	$69,000	$5,000	$5,000	$5,000	$5,000	$10,392	$10,392	$572	$572	$572	$572
		Arsenic treatment facility	E-8	$9,952,000	$2,516,000	$2,516,000	$1,683,000	$1,683,000	$1,683,000	$1,683,000	$899	$899	$601	$601	$601	$601
		Additional groundwater well	E-9	$1,244,471	$106,000	$106,000	$19,000	$19,000	$19,000	$19,000	$110	$110	$6	$6	$6	$6
	City of El Paso (EPWU)	Municipal conservation programs	E-10	$0	$1,200,000	$1,200,000	$1,200,000	$1,200,000	$1,200,000	$1,200,000	$642	$569	$1,034	$471	$217	$203
		Advanced purified water at the Haskell and NW WWTPs	E-11	$291,800,000			$8,498,821	$17,802,675	$20,396,935	$25,500,521			$2,833	$2,374	$1,700	$1,545
		Advanced purified water at the Bustamante WWTP	E-12	$94,096,000	$13,372,000	$13,922,000	$6,653,000	$6,653,000	$6,653,000	$6,653,000	$1,672	$1,547	$665	$665	$665	$665
		Recharge of Hueco Aquifer groundwater with treated surface water from Jonathan Rogers Plant	E-13	$2,495,000	$2,015,000	$2,015,000	$1,806,000	$1,806,000	$1,806,000	$1,806,000	$403	$403	$361	$361	$361	$361
		Treatment & reuse of agricultural drain water	E-14	$41,679,000		$5,008,000	$5,008,000	$1,520,000	$1,520,000	$1,520,000		$1,900	$1,900	$563	$563	$563
		Expansion of local well fields	E-15	$32,712,000	$618,000	$1,236,000	$1,398,000	$1,560,000	$1,722,000	$1,884,000	$159	$159	$120	$101	$89	$81
		Brackish Groundwater at the Jonathan Rogers WTP	E-16	$65,865,000			$10,208,000	$10,208,000	$4,696,000	$4,696,000			$928	$928	$427	$427
		Expansion of the Kay Bailey Hutchison Desal Plant	E-17	$37,200,000	$1,587,000	$4,201,000	$3,106,000	$1,091,000	$1,091,000	$1,091,000	$1,260	$1,667	$1,233	$433	$433	$433
		Groundwater from Hueco Ranch	E-18	$155,858,000			$16,562,000	$16,562,000	$3,520,000	$3,520,000			$3,312	$3,312	$704	$704
		Groundwater from Southern Hudspeth County	E-19	$98,980,000	$14,656,000	$14,656,000	$6,373,000	$6,373,000	$6,373,000	$6,373,000	$1,466	$1,466	$637	$637	$637	$637
		Expansion of the Jonathan Rogers WTP	E-20	$95,186,653	$11,031,163	$11,031,163	$3,066,163	$3,066,163	$3,066,163	$3,066,163	$1,700	$1,700	$472	$472	$472	$472
		Riverside Regulating Reservoir	E-21	$20,754,157	$2,214,290	$2,214,290	$1,737,000	$1,737,000	$1,737,000	$1,737,000	$300	$300	$73	$73	$73	$73
		Groundwater from Diablo Farms	E-22	$273,507,000				$27,771,000	$27,771,000	$4,884,000				$2,777	$2,777	$488
		Groundwater from Dell City area	E-23	$303,185,000					$24,195,000	$39,898,000					$2,420	$3,990
	Lower Valley Water District	Public conservation education	E-24	$0	$30,456	$38,722	$36,494	$35,450	$34,519	$33,826	$852	$890	$718	$605	$521	$460
		Purchased water from EPWU	E-25	$0	$1,070,000	$1,407,000	$1,729,000	$2,064,000	$2,398,000	$2,715,000	$436	$436	$436	$436	$436	$436

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

County	Water User Group	Strategy	Strategy ID	Total Capital Cost*	Total Annual Cost						Cost per Acre-Foot/Year					
					2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
El Paso	Lower Valley Water District	Surface water treatment plant & transmission line	E-26	$34,080,000	$4,390,000	$4,390,000	$4,390,000	$1,640,000	$1,640,000	$1,640,000	$864	$864	$864	$60	$60	$60
		Groundwater from proposed Well field	E-27	37,490,000	$6,950,000	$6,950,000	$6,950,000	$3,930,000	$3,930,000	$3,930,000	$912	$912	$912	$55	$55	$55
		Groundwater from proposed Well field	E-28	$41,070,000	$7,960,000	$7,960,000	$7,960,000	$4,650,000	$4,650,000	$4,650,000	$1,046	$1,046	$1,046	$63	$63	$63
		Wastewater treatment facility and ASR	E-29	$18,108,000	$2,643,000	$2,643,000	$1,128,000	$1,128,000	$1,128,000	$1,128,000	$694	$694	$42	$42	$42	$42
	City of Socorro	Public conservation education	E-30	$0	$29,625	$33,814	$37,703	$41,559	$45,210	$48,642	$933	$981	$1,015	$1,032	$1,036	$1,037
		Purchased water from LVWD	E-31	$0	$95,000	$213,000	$330,000	$466,000	$613,000	$755,000	$438	$436	$436	$436	$436	$436
	Horizon City	Public conservation education	E-32	$0	$22,886	$32,796	$41,999	$51,122	$38,135	$67,881	$513	$520	$522	$523	$334	$524
		Purchased water from Horizon Regional MUD	E-33	$0	$589,000	$1,397,000	$2,154,000	$2,908,000	$3,622,000	$4,296,000	$436	$436	$436	$436	$436	$436
	Horizon Regional MUD	Public conservation education	E-34	$0	$18,336	$25,442	$38,356	$36,673	$35,345	$34,417	$499	$507	$610	$485	$404	$348
		Additional wells & expansion of desal plant	E-35	$56,443,000	$11,320,000	$11,320,000	$6,597,000	$6,597,000	$6,597,000	$6,597,000	$4,379	$1,957	$750	$560	$451	$381
	Fort Bliss	Public conservation education	E-36	$0	$18,702	$19,441	$19,363	$19,334	$19,280	$19,230	$1,135	$1,170	$1,142	$1,105	$1,071	$1,039
		Purchased water from EPWU	E-37	$0				$34,000	$34,000	$34,000				$340	$340	$340
	El Paso County Tornillo WID	Additional groundwater well & transmission line	E-38	$1,726,000	$199,000	$199,000	$55,000	$55,000	$55,000	$55,000	$600	$600	$166	$166	$166	$166
		Arsenic treatment facility	E-39	$3,114,000	$622,000	$622,000	$361,000	$361,000	$361,000	$361,000	$2,251	$2,251	$1,307	$1,307	$1,307	$1,307
	City of Vinton	High capacity water lines for improved distribution of water from EPWU	E-40	$4,192,000	$351,000	$351,000	$0	$0	$0	$0	$877	$877	$0	$0	$0	$0
	El Paso County Other	Public conservation education	E-41	$0	$0	$1,818	$1,688	$1,674	$1,584	$1,490	$0	$200	$200	$200	$200	$200
		Purchased water from EPWU	E-42	$0	$250,000	$519,000	$760,000	$1,191,000	$1,534,000	$1,864,000	$679	$679	$679	$679	$679	$679
	El Paso County Irrigation (EPCWID #1)	Irrigation scheduling	E-43	$0	$102,595	$102,595	$102,595	$102,595	$102,595	$102,595	$59	$59	$59	$59	$59	$59
		Tailwater reuse	E-44	$0	$973,368	$973,368	$973,368	$973,368	$973,368	$973,368	$565	$565	$565	$565	$565	$565
		Improvements to water district delivery system	E-45	$157,777,783	$216,155	$216,155	$216,155	$216,155	$216,155	$216,155	$9	$9	$9	$9	$9	$9
	El Paso County Manufacturing	Purchased water from EPWU	E-46	$0	$10,326,000	$11,643,000	$12,916,000	$13,998,000	$15,722,000	$17,578,000	$1,168	$1,168	$1,168	$1,168	$1,168	$1,168
	El Paso County Mining	Additional groundwater wells	E-47	$969,000				$214,000	$214,000	$133,000				$116	$116	$72
	El Paso County Steam Electric Power	Purchased water from EPWU	E-48	$0	$1,734,000	$2,292,000	$2,971,000	$3,799,000	$4,809,000	$6,009,000	$475	$475	$475	$475	$475	$475
Hudspeth	Hudspeth County-Other (Dell City)	Water loss audit and main-line repair	E-49	$1,614,000	$145,000	$145,000	$10,000	$10,000	$10,000	$10,000	$102,837	$102,837	$5,656	$5,656	$5,656	$5,656
		Brackish groundwater desal facility	E-50	$1,299,000	$282,000	$282,000	$173,000	$173,000	$173,000	$173,000	$2,542	$2,542	$1,562	$1,562	$1,562	$1,562
	Hudspeth County-Other (Fort Hancock WCID)	Water loss audit and main-line repair	E-51	$292,000	$26,000	$26,000	$2,000	$2,000	$2,000	$2,000	$10,039	$10,039	$552	$552	$552	$552
		Additional well & RO treatment facility	E-52	$6,109,000	$1,095,000	$1,095,000	$584,000	$584,000	$584,000	$584,000	$1,939	$1,939	$1,034	$1,034	$1,034	$1,034

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

County	Water User Group	Strategy	Strategy ID	Total Capital Cost*	Total Annual Cost						Cost per Acre-Foot/Year					
					2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
Hudspeth	Hudspeth County-Other (City of Sierra Blanca - Hudspeth Co. WCID #1)	Additional transmission line to supply connections outside of the District	E-53	$1,429,000	$153,000	$153,000	$33,000	$33,000	$33,000	$33,000	$437	$437	$96	$96	$96	$96
	Hudspeth Irrigation (HCCRD #1)	Additional groundwater wells	E-54	$173,000	$18,000	$18,000	$4,000	$4,000	$4,000	$4,000	$81	$81	$18	$18	$18	$18
	Hudspeth Irrigation (HCUWCD #1)	Irrigation scheduling	E-55	$0	$289,157	$289,157	$289,157	$289,157	$289,157	$289,157	$82	$82	$82	$82	$82	$82
		Tailwater reuse	E-56	$0	$207,394	$207,394	$207,394	$207,394	$207,394	$207,394	$352	$352	$352	$352	$352	$352
	Hudspeth County Mining	Additional groundwater well	E-57	$449,000	$43,000	$43,000	$5,000	$5,000	$5,000	$5,000	$1,433	$1,433	$166	$166	$166	$166
Jeff Davis	Fort Davis WSC	Additional groundwater well	E-58	$507,000	$69,000	$69,000	$27,000	$27,000	$27,000	$27,000	$252	$252	$100	$100	$100	$100
		Additional transmission line to connect Fort Davis WSC to Fort Davis Estates	E-59	$1,068,000	$109,000	$109,000	$20,000	$20,000	$20,000	$20,000	$961	$961	$177	$177	$177	$177
	Jeff Davis County-Other (Town of Valentine)	Additional groundwater well	E-60	$402,808	$52,000	$52,000	$18,000	$18,000	$18,000	$18,000	$800	$800	$44	$44	$44	$44
Presidio	City of Marfa	Additional groundwater well	E-61	$1,143,000	$183,000	$183,000	$80,000	$80,000	$80,000	$80,000	$233	$233	$111	$111	$111	$111
	City of Presidio	Water loss audit and main-line repair	E-62	$2,172,000	$195,000	$195,000	$13,000	$13,000	$13,000	$13,000	$21,691	$21,691	$1,193	$1,193	$1,193	$1,193
		Additional groundwater well	E-63	$1,861,000	$187,000	$187,000	$31,000	$31,000	$31,000	$31,000	$1,558	$1,558	$86	$86	$86	$86

2016 Alternate Water Management Strategy

County	Water User Group	Strategy	Strategy ID	Total Capital Cost*	Total Annual Cost						Cost per Acre-Foot/Year					
					2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
Terrell	Terrell County Mining	Additional groundwater wells	E-64	$738,000	$123,000	$123,000	$61,000	$61,000	$61,000	$61,000	$220	$220	$109	$109	$109	$109

*Total capital costs are estimated based on September 2013 US dollars.

Table 5-4. Summary of Recommended and Alternate Water Management Strategy Environmental Assessments (Rio Grande River Basin)

County	Water User Group	Strategy	Strategy ID	Total Number of Rare, Threatened & Endangered Species in County*	Environmental Impact Factors ** Water Needs	Habitat	Cultural Resources	Water Quality	Bays & Estuaries ***	Area Impacted and Resulting Conditions
					(1-5)	(1-5)	(1-5)	(1-5)	(1-5)	
Brewster	Brewster County-Other (Marathon WSSService)	Water loss audit and main-line repair	E-1	155	2	2	2	2		Intended to reduce water loss.
	Brewster County-Other (Rio Grande Village BBNP)	Water loss audit and main-line repair	E-2		2	2	2	2		Intended to reduce water loss.
	Brewster County Other (Panther Junction Plt)	Water loss audit and main-line repair	E-3		2	2	2	2		Intended to reduce water loss.
Culberson	City of Van Horn	Water loss audit and main-line repair	E-4	66	2	2	2	2		Intended to reduce water loss.
	Culberson County Mining	Additional groundwater wells	E-5		2	3	2	2		Temporary land disturbance during drilling of well and construction of connecting pipeline. (4 wells)
		Additional groundwater well	E-6		2	3	2	2		Temporary land disturbance during drilling of well and construction of connecting pipeline. (1 well)
El Paso	Town of Anthony	Water loss audit and main-line repair	E-7	51	2	2	2	2		Intended to reduce water use.
		Arsenic treatment facility	E-8		2	3	2	2		Temporary land disturbance during construction of facilities.
		Additional groundwater well	E-9		2	3	2	2		Temporary land disturbance during drilling of well and construction of connecting pipeline. (1 well)
	City of El Paso (EPWU)	Municipal conservation programs	E-10		2	2	2	2		Intended to reduce water use.
		Advanced purified water at the Haskell and NW WWTPs	E-11		2	3	2	2		Temporary land disturbance during construction of facilities.
		Advanced purified water at the Bustamante WWTP	E-12		2	3	2	2		Temporary land disturbance during construction of facilities.
		Recharge of Hueco Aquifer groundwater with treated surface water from Jonathan Rogers Plant	E-13		2	1	2	2		Six spreading basins will be excavated on EPWU property, which will temporarily hold surface water for infiltration.
		Treatment & reuse of agricultural drain water	E-14		2 and 3	2	2	2		Temporary land disturbance during construction of facilities. Reduced water in drains may occur.
		Expansion of local well fields	E-15		2	3	2	2		Temporary land disturbance during drilling of well and construction of connecting pipeline. (24 wells)
		Brackish Groundwater at the Jonathan Rogers WTP	E-16		2	3	2	2		Temporary land disturbance during drilling of well and construction of connecting pipeline and plant expansion. (10 wells)
		Expansion of the Kay Bailey Hutchison Desal Plant	E-17		2	3	2	2		Temporary land disturbance during drilling of well and construction of connecting pipeline and plant expansion. (7 wells)
		Groundwater from Hueco Ranch	E-18		2	3	2	2		Temporary land disturbance during drilling of well and construction of connecting pipeline. (9 wells)
		Groundwater from Southern Hudspeth County	E-19		2	3	2	2		Temporary land disturbance during drilling of well and construction of connecting pipeline. (14 wells)
		Expansion of the Jonathan Rogers WTP	E-20		2	3	2	2		Temporary land disturbance during construction of facilities.
		Riverside Regulating Reservoir	E-21		1 and 3	1 and 3	2	2		Construction of a 4,100 acre-foot ring levy regulating reservoir. Formally the location of several wastewater disposal ponds. Surface water impoundment habitat will be created; however, a minor amount of flood overflow will be diverted from downstream flow.
		Groundwater from Diablo Farms	E-22		2	3	2	2		Temporary land disturbance during drilling of well and construction of connecting pipeline.
		Groundwater from Dell City area	E-23		2	3	2	2		Temporary land disturbance during drilling of well and construction of connecting pipeline.
	Lower Valley Water District	Public conservation education	E-24		2	2	2	2		Intended to reduce water use.
		Purchased water from EPWU	E-25		2	2	2	2		Causes no change in existing conditions.

Table 5.4. (Continued) Summary of Recommended and Alternate Water Management Strategy Environmental Assessments (Rio Grande River Basin)

County	Water User Group	Strategy	Strategy ID	Total Number of Rare, Threatened & Endangered Species in County*	Environmental Impact Factors **					Area Impacted and Resulting Conditions
					Water Needs (1-5)	Habitat (1-5)	Cultural Resources (1-5)	Water Quality (1-5)	Bays & Estuaries *** (1-5)	
El Paso	Lower Valley Water District	Surface water treatment plant & transmission line	E-26	51 continued	2	3	2	2		Temporary land disturbance during construction of facilities.
		Groundwater from proposed Well field	E-27		2	3	2	2		Temporary land disturbance during drilling of well and construction of connecting pipeline. (7 wells)
		Groundwater from proposed Well field	E-28		2	3	2	2		Temporary land disturbance during drilling of well and construction of connecting pipeline. (7 wells)
		ASR facility	E-29		2	3	2	2		Temporary land disturbance during construction of facilities.
	City of Socorro	Public conservation education	E-30		2	2	2	2		Intended to reduce water use.
		Purchased water from LVWD	E-31		2	2	2	2		Causes no change in existing conditions.
	Horizon City	Public conservation education	E-32		2	2	2	2		Intended to reduce water use.
		Purchased water from Horizon MUD	E-33		2	2	2	2		Causes no change in existing conditions.
	Horizon Regional MUD	Public conservation education	E-34		2	2	2	2		Intended to reduce water use.
		Additional wells & expansion of desal plant	E-35		2	3	2	2		Temporary land disturbance during drilling of nine well and construction of connecting pipeline and plant expansion.
	Fort Bliss	Public conservation education	E-36		2	2	2	2		Intended to reduce water use.
		Purchased water from EPWU	E-37		2	2	2	2		Causes no change in existing conditions.
	El Paso County Tornillo WID	Additional groundwater well & transmission line	E-38		2	3	2	2		Temporary land disturbance during drilling of well and construction of connecting pipeline. (1 well)
		Arsenic treatment facility	E-39		2	3	2	2		Temporary land disturbance during construction of facilities.
	City of Vinton	High capacity water lines for improved distribution of water from EPWU	E-40		2	3	2	2		Temporary land disturbance during construction of facilities.
	El Paso County-Other	Public conservation education	E-41		2	2	2	2		Intended to reduce water loss.
		Purchased water from EPWU	E-42		2	2	2	2		Causes no change in existing conditions.
	El Paso County Irrigation (EPCWID #1)	Irrigation scheduling	E-43		2	2	2	2		Causes no change in existing conditions.
		Tailwater reuse	E-44		2	2	2	2		Causes no change in existing conditions.
		Improvements to water district delivery system	E-45		3	3	2	2		Minor land disturbance will occur as existing canals are concrete lined.
	El Paso County Manufacturing	Purchased water from EPWU	E-46		2	2	2	2		Causes no change in existing conditions.
	El Paso County Mining	Additional groundwater wells	E-47		2	3	2	2		Temporary land disturbance during drilling of well and construction of connecting pipeline. (2 wells)
	El Paso County Steam Electric Power	Purchased water from EPWU	E-48		2	2	2	2		Causes no change in existing conditions.
Hudspeth	Hudspeth County-Other (Dell City)	Water loss audit and main-line repair	E-49	62	2	2	2	2		Intended to reduce water loss.
		Brackish groundwater desal facility	E-50		2	2	2	2		Causes no change in existing conditions.
	Hudspeth County Other (Fort Hancock WCID)	Water loss audit and main-line repair	E-51		2	2	2	2		Intended to reduce water loss.
		Additional well & RO treatment facility	E-52		2	3	2	2		Temporary land disturbance during drilling of well and construction of connecting pipeline and plant facility. (1 well)

Table 5.4. (Continued) Summary of Recommended and Alternate Water Management Strategy Environmental Assessments (Rio Grande River Basin)

County	Water User Group	Strategy	Strategy ID	Total Number of Rare, Threatened & Endangered Species in County*	Environmental Impact Factors ** Water Needs (1-5)	Habitat (1-5)	Cultural Resources (1-5)	Water Quality (1-5)	Bays & Estuaries *** (1-5)	Area Impacted and Resulting Conditions
Hudspeth	Hudspeth County Other (City of Sierra Blanca - Hudspeth Co. WCID #1)	Additional transmission line to supply connections outside of the District	E-53	62 continued	2	3	2	2		Temporary land disturbance during construction of connecting pipeline.
	Hudspeth Irrigation (HCCRD #1)	Additional groundwater wells	E-54		2	3	2	2		Temporary land disturbance during drilling of well and construction of connecting pipeline. (2 wells)
	Hudspeth Irrigation (HCUWCD #1)	Irrigation scheduling	E-55		2	2	2	2		Causes no change in existing conditions.
		Tailwater reuse	E-56		2	2	2	2		Causes no change in existing conditions.
	Hudspeth County Mining	Additional groundwater well	E-57		2	3	2	2		Temporary land disturbance during drilling of well and construction of connecting pipeline. (1 well)
Jeff Davis	Fort Davis WSC	Additional groundwater well	E-58	82	2	3	2	2		Temporary land disturbance during drilling of well and construction of connecting pipeline. (1 well)
		Additional transmission line to connect Fort Davis WSC to Fort Davis Estates	E-59		2	3	2	2		Temporary land disturbance during construction of connecting pipeline.
	Jeff Davis County Other (Town of Valentine)	Additional groundwater well	E-60		2	3	2	2		Temporary land disturbance during drilling of well and construction of connecting pipeline. (1 well)
Presidio	City of Marfa	Additional groundwater well	E-61	86	2	3	2	2		Temporary land disturbance during drilling of well and construction of connecting pipeline. (1 well)
	City of Presidio	Water loss audit and main-line repair	E-62		2	2	2	2		Intended to reduce water loss.
		Water supply for the City of Presidio	E-63		2	3	2	2		Temporary land disturbance during drilling of well and construction of connecting pipeline. (1 well)
Terrell	Terrell County Mining	Additional groundwater wells	E-64	155	2	3	2	2		Temporary land disturbance during drilling of well and construction of connecting pipeline. (6 wells)

* Texas Parks & Wildlife Department's Natural Diversity Database of Rare, Threatened and Endangered Species. Individual species impact is not determined.

See Appendix 5B for quantification description of impact ranges.

** Environmental 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.

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 provides a road map for integrating conservation planning into long-range water supply management goals.

5.3.1 Water Conservation Overview

5.3.1.1 Water Conservation Planning

The Texas Water Development Board 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. The mission of the water conservation staff is to provide leadership, planning, financial assistance, information and education for water conservation processes in Texas.

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 implemented by municipalities, water providers, and other water users supersede recommendations in this plan and are considered consistent with this plan.

The Texas Water Development Board and the Texas State Soil and Water Conservation Board 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 2006 report titled "An Assessment of Water Conservation in Texas, Prepared for the 80th Texas Legislature" (http://www.twdb.texas.gov/publications/reports/special_legislative_reports/doc/TWDBTSSWCB_80th.pdf) 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; and
- An assessment of the TWDB's agricultural water conservation program.

Texas Water Code §11.1271 requires water conservation plans for all municipal and industrial water users with surface water rights of 1,000 acre-feet per year or more and irrigation water users with surface water rights of 10,000 acre-feet per year or more. Water conservation plans of three entities in Far West Texas that meet these criteria were reviewed for this *Plan* including El Paso Water Utilities, El Paso County Water Improvement District No.1, and Hudspeth County Conservation and Reclamation District No.1. 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.

5.3.1.2 Model Water Conservation Plans

Water Conservation Plan forms are available from TCEQ in WordPerfect and PDF formats. The forms for the following entity types listed below are available at: http://www.tceq.state.tx.us/permitting/water_supply/water_rights/conserve.html. You can receive a print copy of a form by calling 512/239-4691 or by email to wras@tceq.state.tx.us.

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/Mining Use – Industrial/Mining Water Conservation Plan (TCEQ-10213) 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

5.3.1.3 State Water Conservation Programs and Guides

Water-Saving Plumbing Fixture Program

The Texas Legislature created the Water-Savings Plumbing Fixture Program in 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 with specific water use efficiency standards.

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.

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 Water Conservation Best Management Practices Guides for agricultural, commercial, institutional, and industrial water users. In addition, guides were developed for both municipal and wholesale water providers. 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 at the following TWDB website: http://www.twdb.texas.gov/conservation/BMPs/

Water Conservation Tips

The TWDB provides a significant amount of information and services pertaining to water conservation that can be accessed at: http://www.twdb.texas.gov/conservation/index.asp. Likewise, water conservation tips were developed by the TCEQ's Clean Texas 2000 and can be accessed at the following website: http://www.tceq.texas.gov/response/drought/drought_tips.html.

5.3.1.4 Regional Conservation Water Management Strategies

Many of the recommended water management strategies listed in Table 5-2 are classified as “Conservation”. Conservation strategies are considered the first method of management when considering meeting future water needs. Conservation strategies include:

- Reuse of treated wastewater
- Water loss audit and main-line repair
- Public education

The *2016 Far West Texas Water Plan* recommends the following 23 conservation related strategies presented in Table 5-5.

Table 5-5. Summary of Recommended Conservation Water Management Strategy Evaluations (Rio Grande River Basin)

County	Water User Group	Strategy	Source	2016 Strategy ID	Strategy Supply (Acre-Feet/Year)						Total Capital Cost
					2020	2030	2040	2050	2060	2070	
Brewster	Brewster County Other (Marathon WSSService)	Water loss audit and main-line repair	Conservation	E-1	65	65	65	65	65	65	$426,000
	Brewster County Other (Rio Grande Village BBNP)	Water loss audit and main-line repair	Conservation	E-2	6	6	6	6	6	6	$607,000
	Brewster County Other (Panther Junction Plt)	Water loss audit and main-line repair	Conservation	E-3	2	2	2	2	2	2	$759,000
Culberson	City of Van Horn	Water loss audit and main-line repair	Conservation	E-4	30	30	30	30	30	30	$1,197,000
El Paso	Town of Anthony	Water loss audit and main-line repair	Conservation	E-7	7	7	7	7	7	7	$759,000
	City of El Paso (EPWU)	Municipal conservation programs	Conservation	E-10	1,870	2,110	1,160	2,550	5,530	5,910	$0
		Advanced purified water at the Haskell and NW WWTPs	Reuse Treated Wastewater	E-11			3,000	7,500	12,000	16,500	$291,800,000
		Advanced purified water at the Bustamante WWTP	Reuse Treated Wastewater	E-12	8,000	9,000	10,000	10,000	10,000	10,000	$94,096,000
		Treatment & reuse of agricultural drain water	Reuse of Agricultural Drain Water	E-14		2,700	2,700	2,700	2,700	2,700	$41,679,000
	Lower Valley Water District	Public conservation education	Conservation	E-24	36	43	51	59	66	73	$0
	City of Socorro	Public conservation education	Conservation	E-30	32	34	37	40	44	47	$0
	Horizon City	Public conservation education	Conservation	E-32	45	63	80	98	114	130	$0
	Horizon Regional MUD	Public conservation education	Conservation	E-34	37	50	63	76	88	99	$0
	Fort Bliss	Public conservation education	Conservation	E-36	16	17	17	18	18	19	$0
	El Paso County Other	Public conservation education	Conservation	E-41	0	9	8	8	8	7	$0
	*El Paso County Irrigation (EPCWID #1)	Irrigation scheduling	Conservation	E-43	1,740	1,740	1,740	1,740	1,740	1,740	$0
		Tailwater reuse	Conservation	E-44	1,723	1,723	1,723	1,723	1,723	1,723	$0
		Improvements to water district delivery system	Conservation	E-45	25,000	25,000	25,000	25,000	25,000	25,000	$157,777,783
Hudspeth	Hudspeth County Other (Dell City)	Water loss audit and main-line repair	Conservation	E-49	1	1	1	1	1	1	$1,614,000
	Hudspeth County Other (Fort Hancock WCID)	Water loss audit and main-line repair	Conservation	E-51	3	3	3	3	3	3	$292,000
	Hudspeth Irrigation (HCUWCD #1)	Irrigation scheduling	Conservation	E-55	3,535	3,535	3,535	3,535	3,535	3,535	$0
		Tailwater reuse	Conservation	E-56	589	589	589	589	589	589	$0
Presidio	City of Presidio	Water loss audit and main-line repair	Conservation	E-62	9	9	9	9	9	9	$2,172,000

5.3.1.5 Municipal Conservation Programs

El Paso Water Utilities (EPWU) is the largest supplier of municipal water in Far West Texas, supplying approximately 72 percent of all municipal needs in 2020. The City of El Paso through EPWU has been implementing an aggressive water conservation program for the past two decades and has reduced the per capita demand from 200 gpcd in 1990 to a current level of less than 130 gpcd. The overall per capita potable water use for EPWU and its wholesale customers, including steam electric and industrial use, was about 130 gpcd in 2013. EPWU intends to continue its aggressive water conservation efforts, and estimates that demand can be reduced by about 3 gpcd per decade by conservation efforts. The continuation of the conservation effort is a key component of the El Paso Integrated Water Management Strategy discussed in Chapter 5.

Irrigation represents approximately 77 percent of all the water used in Far West Texas. Most of this water is diverted from the Rio Grande and is applied to crops on farms located along the Rio Grande floodplain in El Paso, Hudspeth, and Presidio Counties. During significantly dry periods, insufficient water is available in upstream reservoirs 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 a number of 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 Far West Texas. 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.

A one-day conference sponsored by EPWU was held on October 17, 2008 to discuss municipal conservation. The goal for the conference was technology and information transfer based on EPWU success. The conference is an ongoing intraregional cooperative effort to share information so that regional water purveyors can implement programs that fit their needs in their planning strategies. The El Paso site (TecH2O Center) hosted the one-day conference with two tracks, the Utility Staff Track and the Community Outreach Track. An EPWU facilitator and an Extension Agent were sent to the Fort Stockton Extension Center to host the Community Outreach Track. Both sites were linked via long-distance conferencing and video. A total of 55 registrations were received: 32 for the Community Outreach Track and 23 for the Utility Staff Track. The EPWU Webmaster reported 140 web link requests from the link that contained the conference presentations. The full report on the conference is provided in Appendix 1D of Chapter 1 of this *Plan*.

The Utility Staff Track was designed for the technical staff and incorporated sessions regarding BMPs found on the State guide. The Community Outreach Track was planned for those who help utility staff disseminate educational presentations into the community such as extension agents, teachers, and master volunteers. This track introduced many of the available school curriculum programs on water conservation. Attending teachers received professional credit hours for their participation in the conference.

5.3.1.6 Public Education BMPs

Local officials would offer water conservation education to schools, civic associations, include information in water bills, provide pamphlets and other materials as appropriate. It was assumed that the education and outreach programs would be needed throughout the planning period in order to maintain the level of water savings.

5.3.1.7 Irrigation Conservation Strategy Analysis

Staff of the Texas AgriLife Research Center at El Paso evaluated the applicability, water savings potential, implementation feasibility, and cost effectiveness of seventeen irrigated agriculture water conservation practices in Far West Texas during both drought and full water supply conditions. Agricultural, hydrologic, engineering, economic, and institutional conditions are identified and examined for the three largest irrigated agricultural areas which account for over 90 percent of total irrigated agricultural acreage in Far West Texas. Factors considered in evaluating conservation strategies included water sources, use, water quality, cropping patterns, current irrigation practices, delivery systems, technological alternatives, market conditions and operational constraints.

The overall conclusion is that very limited opportunities exist for significant additional water conservation in Far West Texas irrigated agriculture. The primary reasons can be summarized by:

- the most effective conservation practices have already been implemented and associated water savings realized throughout the region;
- reduced water quality and the physical nature of gravity flow delivery limit or prohibit implementation of higher efficiency pressurized irrigation systems;
- increased water use efficiency upstream has the net effect of reducing water supplies and production of downstream irrigators; and,
- water conservation implementation costs for a number of practices exceed the agricultural value and benefits of any water saved.

Those practices that suggest economic efficient additional water conservation included lining or pipelining district canals and the very small potential for additional irrigation scheduling and tail water recovery systems. In nearly all cases, these practices have been adopted to a large extent if applicable, further emphasizing the very limited opportunities for additional conservation. If all of these strategies were implemented, the water conserved would satisfy less than 25 percent of the projected unmet agricultural water demand in 2060 during drought-of-record conditions.

The full report on the irrigation conservation analysis is available at http://www.twdb.texas.gov/publications/reports/contracted_reports/doc/0704830690_RegionE/TxAgriLifeResearchIrrigationEfficiency-FinalReport.pdf.

5.3.1.8 Water Loss Audit and Main-line Repair

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 TWDB report 376 titled 'Water Loss Audit Manual for Texas Utilities' can be accessed at: http://www.twdb.texas.gov/publications/brochures/conservation/doc/WaterLossManual_2008.pdf.

A summary of the first audit, An Analysis of Water Loss as Reported by Public Water Suppliers – 2007 was provided to the Far West Texas Water Planning Group (FWTWPG) for consideration in developing water supply management strategies. This document can be accessed from the TWDB website in its entirety at:

Volume I - https://www.twdb.texas.gov/publications/reports/contracted_reports/doc/0600010612_WaterLossinTexas.pdf

Volume II - https://www.twdb.texas.gov/publications/reports/contracted_reports/doc/0600010612_waterlossintexas_appendix.pdf

Table 1-2 in Chapter 1, Section 1.9 provides a listing of reported utility audits performed in Far West Texas in 2010.

Water Loss Audit Resources

The TWDB provides a significant amount of information and services pertaining to water loss audit that can be accessed at: https://www.twdb.texas.gov/conservation/resources/waterloss-resources.asp. 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

5.3.2 Water User Group Conservation Management Plans

In the consideration of regional conservation, the Far West Texas Water Planning Group reviewed active water conservation management plans provided to the planning group by the following entities.

Public Supply Entities

City of Alpine - *Water Conservation Management Plan* (August 2005)
http://www.ci.alpine.tx.us/

Dell City – *Water Conservation and Drought Contingency Plan* (August 2000)

El Paso County WCID #4 – *Drought Contingency Plan* (August 2000)

El Paso Water Utilities – *EPWU Water Conservation Management Plan* (2009)
http://www.epwu.org/

Esperanza Water Service Company – *Drought Contingency Plan* (August 2000)

Fort Bliss WSC – *Water Conservation Management Plan* http://www.asusinc.com

Fort Davis WSC – *Drought Contingency Plan* (August 2000) http://www.fortdavis.com

Fort Davis Estates – *Drought Contingency Plan* (August 2001)

Green Acres/River View Water Works – *Drought Contingency Plan* (August 2000)

Horizon Regional MUD – *Water Conservation Management Plan* (June 2008)
http://horizonregional.com/

Lajitas Utility Company – *Drought Contingency Plan* (November 2005)

Lower Valley Water District – *Water Conservation Management Plan* (January 2007)
http://www.lvwd.org/

Marfa City Water Works – *Water Conservation Management Plan* (June 2007)

Marathon Water Supply and sewer Service Corp. – *Drought Contingency Plan* (July 2000)

City of Presidio – *Water Conservation Management Plan* (August 2009) http://presidiotx.us/

City of Sanderson – *Comprehensive Plan* (1994) http://www.sandersonchamberofcommerce.info/

Study Butte WSC – *Drought Contingency Plan* (April 2001)

Terrell County WCID No.1 – *Water Conservation Management Plan*
http://sandersonchamberofcommerce.info/services/tcwcid.htm

Turf Water System – *Drought Contingency Plan* (August 2000)

Town of Anthony – *Water Conservation Management Plan* (February 2012)
http://www.townofanthony.org/

Town of Valentine – *Drought Contingency Plan* (August 2000)

Town of Van Horn – *Water Conservation and Drought Contingency Plan* (July 1996)

Villa Alegre estates – *Drought Contingency Plan* (August 2000)

Vinton Hills Water System – *Drought Contingency Plan* (August 2000)

Vinton Village Estates – *Drought Contingency Plan* (August 2000)

Village of Vinton – http://www.vintontx.govoffice2.com/

Irrigation Districts

El Paso County Water Improvement District No.1 – *Management Plan* http://www.epcwid1.org/

Hudspeth County Conservation and Reclamation District No.1 – *Management Plan*

5.3.3 Groundwater Conservation Districts 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." Six districts are currently in operation within the planning region:

- Brewster County Groundwater Conservation District
- Culberson County Groundwater Conservation District
- Hudspeth County Underground Water Conservation District#1
- Jeff Davis County Underground Water Conservation District
- Presidio County Underground Water Conservation District
- Terrell County Groundwater Conservation District

In recent sessions, the Texas Legislature has redefined the manner in which groundwater is to be managed by establishing a process referred to as Groundwater Management Areas http://www.twdb.texas.gov/groundwater/management_areas/index.asp. This new process is summarized in Chapter 1, Section 1.1.5.

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 Texas Administrative Code 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. The following link provides information on desired future conditions. http://www.twdb.texas.gov/groundwater/management_areas/DFC.asp.

The Brewster, Culberson, Hudspeth, Jeff Davis and Presidio districts are in GMA 4. Terrell County Groundwater Conservation District is in GMA 7. As of August 13, 2010, *desired future conditions* have been adopted for the following aquifers: Capitan Reef, Edwards Trinity, Marathon, Rustler, Igneous, Upper Salt Basin, Bone Springs-Victorio Peak, West Texas Bolsons and Presidio-Redford Bolson.

5.3.3.1 Brewster County Groundwater Conservation District

The Brewster County Groundwater Conservation District (http://www.brewstercountygroundwaterdistrict.com) was confirmed in 2001 and serves all of Brewster County, the largest county in the State. The mission of the District is to manage, protect, and conserve the groundwater resources of Brewster County, while protecting private property rights and promoting constructive and sustainable development in the county. The table below presents the adopted DFCs for the aquifers in Brewster County. The approved 2009 Management Plan is available at: http://www.westtexasgroundwater.com/mgmtplan08.html.

Adopted Desired Future Conditions for Brewster County

Aquifer	Capitan Reef Complex	Edwards-Trinity (Plateau)	Igneous	Marathon	Rustler
DFC	0 foot drawdown	3 foot drawdown	10 foot drawdown	0 foot drawdown	0 foot drawdown

5.3.3.2 Culberson County Groundwater Conservation District

The Culberson County Groundwater Conservation District was confirmed in May 1998 and occupies the southwestern half of Culberson County. Aquifers managed by the District primarily include the Wild Horse Flat, Michigan Flat, and Lobo Flat of the West Texas Bolsons, and the Capitan Reef. The table below presents the adopted DFCs for the aquifers in Culberson County. The approved 2013 Management Plan can be accessed at: http://www.twdb.texas.gov/groundwater/docs/GCD/culbersoncgcd/culbersoncgcd_mgmt_plan2014.pdf.

Adopted Desired Future Conditions for Culberson County

Aquifer	Capitan Reef Complex	Edwards-Trinity (Plateau)	Igneous	Upper Salt Basin	West Texas Bolsons
DFC	50 foot drawdown	50 foot drawdown	66 foot drawdown	0 foot drawdown	78 foot drawdown

5.3.3.3 Hudspeth County Underground Water Conservation District #1

The Hudspeth County Underground Water Conservation District #1 (http://www.axiomblair.com/awbprojs/hcuwcd/) was created in 1956 and is located in the Dell Valley irrigation area of northeast Hudspeth County, with the Community of Dell City lying approximately in the center of the District. The principal aquifer in the District is the Bone Spring-Victorio Peak. The District recently installed eight continuous water-level recorders and has placed flow gauges on irrigation wells. The table presents the adopted DFCs for the aquifer in Hudspeth County. The latest District management plan adopted in May of 2013 can be accessed at: http://www.twdb.texas.gov/groundwater/docs/GCD/hcuwcd1/hcuwcd1_mgmt_plan2013.pdf.

Adopted Desired Future Conditions for Hudspeth County

Aquifer	Bone Spring – Victorio Peak
DFC	0 foot drawdown

5.3.3.4 Jeff Davis County Underground Water Conservation District

The Jeff Davis County Underground Water Conservation District was formed in August 1994 (HB 2866) and includes all of Jeff Davis County. Primary aquifers managed by the District include the Ryan Flat and Lobo Flat of the West Texas Bolsons and the Davis Mountains Igneous. District activities include the registration of all new wells and the permitting of wells that are capable of producing 25,000 gallons per day or more. State well construction standards are enforced and water levels are monitored in 28 observation wells located in high use areas. The District is involved in a wellhead protection program with the Fort Davis Water Supply Corp. and also provides educational programs for schools and the public. The table presents the adopted DFCs for the aquifers in Jeff Davis County. The latest District management plan adopted in November of 2013 can be accessed at: http://www.twdb.texas.gov/groundwater/docs/GCD/jdcuwcd/jdcuwcd_mgmt_plan2013.pdf.

Adopted Desired Future Conditions for Jeff Davis County

Aquifer	Edwards-Trinity (Plateau)	Igneous	West Texas Bolsons
DFC	Aquifer non-relevant	20 foot drawdown	72 foot drawdown

5.3.3.5 Presidio County Underground Water Conservation District

Presidio County residents approved the formation of the Presidio County Underground Water Conservation District in an election held August 31, 1999. Primary aquifers to be managed in the District include the Presidio-Redford Bolson, the Ryan Flat West Texas Bolson, and the Davis Mountains Igneous. District activities include well permitting, recharge enhancement, and public education. The table presents the adopted DFCs for the aquifers in Presidio County. The latest District management plan adopted in January of 2015 can be accessed at: http://www.twdb.texas.gov/groundwater/docs/GCD/jdcuwcd/jdcuwcd_mgmt_plan2013.pdf.

Adopted Desired Future Conditions for Presidio County

Aquifer	Igneous	Presidio – Redford Bolsons	West Texas Bolsons
DFC	14 foot drawdown	5 foot drawdown	72 foot drawdown

5.3.3.6 Terrell County Groundwater Conservation District

The creation of the Terrell County Groundwater Conservation District (http://co.terrell.tx.us/default.aspx?Terrell_County/Ground.Water) was approved and confirmed by the voters of Terrell County at the confirmation election held on November 6, 2012. The Edwards-Trinity (Plateau) Aquifer is the primary aquifer managed by the district. The district accomplishes its objectives by working to lessen interference between water wells, minimize drawdown of groundwater levels, prevent the waste of groundwater, and reduce the degradation of groundwater quality. The District is focused on helping the local economy maintain and improve its current condition. District activities include the protection of existing wells, permitting of new wells and public education. The table presents the adopted DFCs for the aquifer in Terrell County. The approved management plan adopted July 2013 can be accessed at: http://www.twdb.texas.gov/groundwater/docs/GCD/tcgcd/tcgcd_mgmt_plan2013.pdf.

Adopted Desired Future Conditions for Terrell County

Aquifer	Edwards-Trinity (Plateau)
DFC	7 foot drawdown

This page intentionally left blank.

APPENDIX 5A
RECOMMENDED AND ALTERNATE WATER MANAGEMENT STRATEGIES

This page intentionally left blank.

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:

Table 5-2

- Quantity adequacy
- Quality adequacy
- Reliability
- Impacts to water, agricultural, and natural resources, and to ecologically unique stream segments

Table 5-3

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

Table 5-4

- 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 2013 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 BREWSTER COUNTY-OTHER

Brewster County-Other consists of rural households outside the service area of the City of Alpine and includes the communities of Marathon, Study Butte, Terlingua, Lajitas, and the Big Bend National Park. The population of Brewster County Other is projected to increase from 3,661 in 2020 to 4,124 in 2070. Water supplies developed for the rural area are predominantly groundwater pumped from the Igneous, Edwards-Trinity (Plateau), and Marathon aquifers. Small communities of Study Butte and Terlingua, as well as the Lajitas Golf Resort obtain groundwater from the underlying Cretaceous formations that comprise the local Cretaceous (other) aquifer. Wells drilled to supply water for the Lajitas Golf Resort have demonstrated that groundwater of likely significant quantity is present in this aquifer system.

Although the supply-demand analysis (Table 4-1) does not project a future water supply deficit for Brewster County Other, the following water management strategies are recommended to enhance the reliability of the future water supply availability for rural and small town residents within Brewster County:

- (E-1) Water loss audit and main-line repair for Marathon Water Supply & Sewer Service Company
- (E-2) Water loss audit and main-line repair for Rio Grande Village BBNP
- (E-3) Water loss audit and main-line repair for Panther Junction BBNP

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. A more detailed description of this best management practice is available in TWDB Report 362, Water Conservation Best Management Practices Guide, and in the TWDB Water Loss Manual. The reliability of this water savings is contingent on the aggressive implementation of this BMP and the public's willingness to do their part. The community should also look towards conservation measures through public information, progressive water rate increases and by implementing a water waste ordinance.

The TWDB requires that water management strategies develop new water to be applicable for SWIFT funding. Projects that involve items such as; replacing and/or repairing old infrastructure, and wastewater collection and treatment generally 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 here: https://www.twdb.texas.gov/financial/index.asp. Study Butte WSC has recently applied for funding utilizing several of the other funding programs found at the above link, for the following projects:

- Replace water distribution lines and install pressure reducing equipment
- Well rehabilitation at the Study Butte WSC water treatment plant

E-1 Water Loss Audit and Main-line Repair for Marathon Water Supply & Sewer Service Company

According to the 2010 TWDB Public Water System Water Loss Survey, Marathon Water Supply & Sewer Service Company had a total water loss of 65,846,393 gallons (201 acre-feet) in 2010 (20.2%) due to leaking distribution lines and/or faulty meters. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. Taking the proper measures to identify and repair old infrastructure and inaccurate water meters, the water supply system can reduce the unaccounted for water and get a more accurate look at water consumption.

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. The strategy assumes 2.2 miles of 6-inch diameter pipe will be replaced, at a total estimated project capital cost of $426,000; and will generate a potential savings of 64.66 acre-feet of water per year.

E-2 Water Loss Audit and Main-line Repair for Rio Grande Village BBNP

According to the 2010 TWDB Public Water System Water Loss Survey, Rio Grande Village BBNP had a total water loss of 3,230,772 gallons (9.9 acre-feet) in 2010 (64.5%) due to leaking distribution lines and/or faulty meters. This amount of water loss is the sum of reported breaks and leaks and unreported loss. Taking the proper measures to identify and repair old infrastructure and inaccurate water meters, the water supply system can reduce the unaccounted for water and get a more accurate look at water consumption.

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. The strategy assumes 3.25 miles of 6-inch diameter pipe will be replaced, at a total estimated project capital cost of $607,000; and will generate a potential savings of 6.35 acre-feet of water per year.

E-3 Water Loss Audit and Main-line Repair for Panther Junction Plt BBNP

According to the 2010 TWDB Public Water System Water Loss Survey, Panther Junction BBNP Plt had a total water loss of 3,551,657 gallons (10.9 acre-feet) in 2010 (20%) due to leaking distribution lines and/or faulty meters. This amount of water loss is the sum of reported breaks and leaks and unreported loss. Taking the proper measures to identify and repair old infrastructure and inaccurate water meters, the water supply system can reduce the unaccounted for water and get a more accurate look at water consumption.

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. The strategy assumes 4 miles of 6-inch diameter pipe will be replaced, at a total estimated project capital cost of $759,000; and will generate a potential savings of 2.18 acre-feet of water per year.

5A.2 WATER MANAGEMENT STRATEGIES FOR THE CITY OF VAN HORN

The City of Van Horn, located in southern Culberson County, relies exclusively on groundwater from wells tapping the Wildhorse Flat portion of the West Texas Bolson Salt Basin Aquifer. The City's population is projected to modestly increase from 2,319 in 2020 to 2,815 by the year-2070. The City provides a significant amount of water supply for several motel facilities catering to the transient motorist along IH-10. Although the supply demand analysis does not project a future water supply deficit for the City of Van Horn, the following water management strategy is recommended to enhance the reliability of the City's future water supply availability:

- (E-4) Water loss audit and main-line repair for the City of Van Horn

E-4 Water Loss Audit and Main-line Repair for the City of Van Horn

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. A more detailed description of this best management practice is available in *TWDB Report 362, Water Conservation Best Management Practices Guide*, and in the *TWDB Water Loss Manual*. The reliability of this water savings is contingent on the aggressive implementation of this BMP and the public's willingness to do their part. The community should also look towards conservation measures through public information, progressive water rate increases and by implementing a water waste ordinance.

According to the 2010 TWDB Public Water System Water Loss Survey, the City of Van Horn had a total water loss of 45,766,627 gallons (140.5 acre-feet) in 2010 (21%) due to leaking distribution lines and/or faulty meters. This amount of water loss is the sum of reported breaks and leaks and unreported loss. Taking the proper measures to identify and repair old infrastructure and inaccurate water meters, the water supply system can reduce the unaccounted for water and get a more accurate look at water consumption.

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. The strategy assumes 6.3 miles of 6-inch diameter pipe will be replaced, at a total estimated project capital cost of $1,197,000; and will generate a potential savings of 29.5 acre-feet of water per year.

5A.3 WATER MANAGEMENT STRATEGIES FOR CULBERSON COUNTY MINING

Culberson County has a water supply deficit for mining use projected at 291 acre-feet per year in 2020 increasing to 1,178 by 2040. Native sulfur occurs predominantly with carbonates as a replacement of calcium sulfate minerals in the Upper Permian (Ochoan) Castile, Salado and Rustler formations. This strata bound ore is mined as a valuable commodity and integral component of the world economy. Sulfur is used to manufacture numerous products including fertilizer and other chemicals. Other mining activities within Culberson County are associated with the oil and gas industry. Local supply in conjunction with groundwater from the Rustler Aquifer and West Texas Bolsons Upper Salt Basin Aquifer, provide the water needed for the mining industry 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 Culberson County:

- (E-5) Additional wells in the Rustler Aquifer
- (E-6) Additional well in the West Texas Bolsons Aquifer (Upper Salt Basin)

E-5 Additional Wells in the Rustler Aquifer

The Rustler Aquifer is a potential source of water to meet the mining water supply shortages within Culberson County. The formation outcrop occurs along the eastern boundary of Culberson County and extends downdip eastward into the adjoining county. The Rustler formation consists mainly of dolomite, limestone and gypsum. Groundwater from this Aquifer is produced primarily from solution channels, caverns and collapsed breccia zones. High concentrations of dissolved solids ranging between 1,000 and 4,600 mg/L render the formation unsuitable as a source of municipal and domestic water supply. However, this water is more than adequate for mining purposes. This strategy assumes that four new wells will be drilled to an approximately 380 feet below the surface.

Quantity, Reliability, and Cost –Historical industrial and agricultural use indicates that the Rustler Aquifer may be a viable source to meet the additional needs of the mining industry. For this *Plan*, the four new wells are assumed to supply an additional 590 acre-feet per year. The reliability of this supply is considered to be high, since water from this formation is used primarily for industrial and agricultural use only. The total capital cost of this project is approximately $608,000.

E-6 Additional Well in the West Texas Bolsons Aquifer (Upper Salt Basin)

The Upper Salt Basin Aquifer is the northern most aquifer of the West Texas Bolsons Aquifer System and is a potential source of water to meet the mining water supply shortages within Culberson County. Groundwater within the Upper Salt Basin varies from fresh to moderately saline ranging between 1,000 and 4,000 milligrams per liter of total dissolved solids. This strategy assumes that one new well will need to be drilled to approximately 550 feet below the surface.

Quantity, Reliability, and Cost – Historical agricultural use indicates that the West Texas Bolsons Aquifer is a viable source. For this *Plan*, one new well is assumed to supply an additional 590 acre-feet per year. The reliability of this supply is considered to be medium to high, based on competing demands. The total capital cost of this project is approximately $675,000.

5A.4 WATER MANAGEMENT STRATEGIES FOR THE CITY OF ANTHONY

The City of Anthony and many other residents of El Paso County rely on the Hueco-Mesilla Bolson Aquifer for municipal, domestic, livestock, and irrigation water supply needs. The City's population is projected to increase from 6,210 in 2020 to 11,889 by 2070. As the population increases, water demands increase. This creates a significant amount of strain on the Hueco-Mesilla Bolson Aquifer. Continued withdrawals from the Aquifer may negatively impact the Aquifer's ability to meet the long-term water supply needs of the area.

The City of Anthony has a projected water supply deficit of 111 acre-feet per year in 2070. The following water management strategies are recommended to enhance the reliability of the City's future water supply availability:

- (E-7) Water loss audit and main-line repair for the Town of Anthony
- (E-8) Arsenic treatment facility
- (E-9) Additional groundwater well

The TWDB requires that water management strategies develop new water 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 here: https://www.twdb.texas.gov/financial/index.asp. The City of Anthony has the following project currently being funded through the TWDB's Clean Water State Revolving Fund (CWSRF).

- Wholesale water treatment plant replacement and expansion

E-7 Water Loss Audit and Main-line Repair

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. A more detailed description of this best management practice is available in *TWDB Report 362, Water Conservation Best Management Practices Guide*, and in the *TWDB Water Loss Manual*. The reliability of this water savings is contingent on the aggressive implementation of this BMP and the public's willingness to do their part. The community should also look towards conservation measures through public information, progressive water rate increases and by implementing a water waste ordinance.

According to the 2010 TWDB Public Water System Water Loss Survey, Town of Anthony had a total water loss of 13,532,691 gallons (41.5 acre-feet) in 2010 (16%) due to leaking distribution lines and/or faulty meters. This amount of water loss is the sum of reported breaks and leaks and unreported loss. Taking the proper measures to identify and repair old infrastructure and inaccurate water meters, the water supply system can reduce the unaccounted for water and get a more accurate look at water consumption.

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. The strategy assumes 4 miles of 6-inch diameter pipe will be replaced, at a total estimated project capital cost of $759,000; and will generate a potential savings of 6.64 acre-feet of water per year.

E-8 Arsenic Treatment Facility

Naturally occurring arsenic is found in the groundwater relied upon by the residents of the Town of Anthony. The community's groundwater supply from the Mesilla Bolson Aquifer hovers around the maximum contaminant limit of 10 ppb. Aided by financial assistance from the TWDB, utilizing the Drinking Water State Revolving Fund, the Town has plans to install an arsenic treatment system to meet the State's water supply and public safety standards. The community has been performing pilot studies on two arsenic removal technologies: absorption and oxidation/removal.

The funding received is also intended to construct a 250,000 gallon elevated storage tank; upgrade pumping stations; install re-chlorination facilities in the distribution system; and rehabilitate or replace water lines. Currently, the Town of Anthony has inadequate storage capacity. Wells and booster stations are in critical need of system upgrades and alternate power supplies; in addition to old and undersized distribution lines.

Quantity, Reliability, and Cost - For this *Plan*, the new arsenic treatment facility is assumed to supply 2,800 acre-feet per year of potable water. Reliability of the project is high since the Mesilla Bolson Aquifer has historically been found as a reliable source. The total capital cost for this project is estimated at $9,952,000. This amount is derived from taking the 2008 TWDB loan application cost and updating it to the 2013 dollar amount using the TWDB Costing Tool.

E-9 Additional Groundwater Well

Due to ongoing drought resulting in lower aquifer water levels and condition of existing wells because of age, the Town of Anthony has experienced a decrease in water production from their three existing municipal water wells. Additionally, one of the three wells has been taken out of service. Preliminary inspection of the well shows that the casing is corroded and fractured allowing sand to enter and fill the well screen. The Town is pursuing rehabilitation of this well. However, based on existing and future water demands, in addition to the condition of the Town's existing wells, a new municipal water well is required to reliably supply additional water. Anticipated depth of the well is 800 feet and a capacity of 1,200 GPM. The Town has identified a location for a new well and has obtained a letter of intent from the land owner to enter into negotiations for purchase of the land.

Quantity, Reliability and Cost – The well is anticipated to reliably provide an additional supply of 960 acre-feet per year from the Mesilla Bolson Aquifer, even though some long-term water level decline can be expected. According to Parkhill Smith & Cooper (project engineers), the estimated budget cost of a new well for the Town of Anthony is $1,244,471. This includes construction, land acquisition, engineering and administration.

5A.5 EL PASO WATER UTILITIES INTEGRATED STRATEGIES

Water resource management opportunities and challenges faced by municipal and industrial users in the City and County of El Paso are unique in Texas in that local surface water and local groundwater are managed conjunctively. The typical approach to strategy development does not address the necessity of linking between individual strategies when conjunctive management is practiced.

The El Paso Water Utilities Integrated Strategy evolved from an analysis of integrated water development strategies for the City and County of El Paso in the *2006 Far West Texas Water Plan*, which was subsequently updated in the *2011 Plan*. The analysis included a discussion of the technical feasibility, cost, environmental – agricultural – natural resource impacts, socioeconomic impact, and water quality. The strategies considered were termed "integrated" because they represented combinations of individual sources due to the unique nature of water management in El Paso. Taken separately, each source could be evaluated and analyzed. However, combining all sources into an integrated strategy provides an opportunity to evaluate the interrelationship of the individual components and provides a regional context to the *Plan*. For this *2016 Plan*, the recommended Integrated Water Management Strategy in the *2011 Far West Texas Water Plan* was updated and several new component strategies have been added.

The non-agricultural demand in El Paso County is projected to be approximately 255,138 acre-feet per year by 2070. El Paso Water Utilities (EPWU) is projected to provide approximately 213,466 acre-feet per year of that water, either to retail customers or as a wholesale supplier. Current supplies for EPWU are composed of conjunctive use of water from the Rio Grande and local groundwater and a water reclamation program. Under the conjunctive use approach, pumping from groundwater is increased when the surface water availability is reduced. Conjunctive use currently provides 121,567 acre-feet per year for EPWU. The water reclamation project provides approximately 8,500 acre-feet per year, for a combined supply 130,067 acre-feet per year. Non-agricultural demand in El Paso County not supplied by EPWU is projected to be approximately 41,672 acre-feet per year in 2070 and will be supplied by groundwater from the Hueco-Mesilla Bolson and the Rio Grande Alluvium Aquifers.

The recommended Integrated Strategy adopted to meet the needs for additional water supply for EPWU is comprised of the following individual strategies listed in the table below.

EPWU Water Management Strategies

Strategy Number	Strategy Name
E-10	Municipal conservation programs
E-11	Advanced Purified Water at the Haskell and Northwest Wastewater Treatment Plants
E-12	Advanced Purified Water at the Bustamante Wastewater Treatment Plant
E-13	Aquifer recharge with treated surface water
E-14	Treatment of agricultural drain water
E-15	Expansion of local well fields
E-16	Brackish groundwater at the Jonathan Rogers Water Treatment Plant
E-17	Expansion of the Kay Bailey Hutchison Desalination Plant
E-18	Groundwater from Hueco Ranch
E-19	Groundwater from Southern Hudspeth County
E-20	Expansion of the Jonathan Rogers Water Treatment Plant
E-21	Riverside Regulating Reservoir
E-22	Groundwater from Diablo Farms
E-23	Groundwater from Dell City

E-10 Municipal Conservation Programs

Reduction of municipal water consumption may be achieved with the implementation of conservation programs that reduce per capita usage and prevent water waste. EPWU has been implementing an aggressive water conservation program for more than 20 years with actions such as adoption of a rate structure that penalizes high consumption, restrictions on residential watering, rebate programs for replacing appliances and bathroom fixtures for low consumption units, plumbing fixtures to reduce leaks, native landscaping programs to reduce landscape irrigation, public education, control of water losses, and enforcement.

Since 1990, the city has had a water conservation department with nine full time staff members overseen by a Water Conservation Manager. The department develops and oversees the City's conservation program, collects data, provides enforcement, and develops public outreach programs.

Reuse is considered a conservation strategy by the TWDB. The City currently has a 'purple pipe' water reuse program that provides treated wastewater for irrigation of golf courses, city parks, school grounds, and apartment landscapes, as well as for construction and industrial use.

EPWU's water conservation efforts have reduced per capita municipal use in El Paso from about 225 gallons per capita per day (gpcd) in the late 1970s to a current level of 132 gpcd. The overall per capita potable water use for EPWU and its wholesale customers, including steam electric and industrial use, was about 130 gpcd in 2013. This strategy assumes the continuation of EPWU aggressive water conservation efforts, and estimates that demand can be reduced by conservation efforts to approximately 118 gpcd by 2060.

Quantity, Reliability, and Cost – The table below presents the additional supplies that would result from this strategy's projected level of conservation.

Projected Conservation Supply (Acre-Feet)

	Historical 2013	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population Served by El Paso Water Utilities	787,208	831,386	938,493	1,038,018	1,136,713	1,230,215	1,318,182
Historical/Projected gpcd	130	130	127	124	123	122	122
Expected gpcd		128	125	123	121	118	118
TWDB Projected Savings (acre-feet/year)		0	3,150	7,000	8,910	11,050	11,810
Savings above TWDB Projected (acre-feet/year)		1,870	2,110	1,160	2,550	5,530	5,910
EPWU Expected Savings (acre-feet/year)		**1,870**	**5,260**	**8,160**	**11,460**	**16,580**	**17,720**

Note: Historical 2013 data provided by EPWU

Projected Cost of El Paso Water Utilities Conservation Strategy

	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Annual Cost	$1,200,000	$1,200,000	$1,200,000	$1,200,000	$1,200,000	$1,200,000
Cost per Acre-Foot	$642	$569	$1,034	$471	$217	$203
Cost per 1,000 gallons	$1.97	$1.75	$3.17	$1.44	$0.67	$0.62

EPWU has successfully reduced per capita demands resulting in considerable water savings. EPWU's expected savings shown in the Table above are a compilation of TWDB projected savings plus the additional projected savings estimated above the TWDB projected savings. These savings are the result of "active" water conservation strategies that conserve water over and beyond what would happen anyway as a result of "passive" water conservation measures that stem from federal and state legislation requiring more efficient plumbing fixtures in new building construction.

EPWU has budgeted $1.2 million for conservation in 2015. Because of the importance of conservation, it has been assumed that EPWU will invest a similar amount in conservation over the planning period. The projects annual costs for water conservation are shown in the table above.

E-11 Advanced Purified Water at the Haskell and Northwest WWTPs

The Haskell Street Wastewater Treatment Plant is located in south central El Paso on the Rio Grande and has a capacity of 27.7 MGD. Treated wastewater effluent from the Haskell WWTP is currently discharged into either the American Canal or the Rio Grande. Discharges into the American Canal may be used for irrigation downstream. The plant is the source for the Central Reclaimed Water Project (purple pipe reuse), which is used to irrigate the Ascarete Golf Course.

The Northwest WWTP is located in northwest El Paso at the intersection of I-10 and Executive Center Blvd. and has a capacity of 17.5 MGD. The treated wastewater effluent provides water for industrial use and city landscape irrigation.

This strategy is assumed to treat wastewater effluent at both plants to potable safe drinking water standards. The purified water would flow directly into the EPWU distribution system. Currently most of the wastewater that is not already being reused as part of a purple pipe reuse project is discharged into a canal system. Much of that water is then used for downstream irrigation, although some of the flow probably also serves to maintain environmental functions. Reuse of additional water may impact those functions, but the overall impact is expected to be small. The conceptual design for this project uses deep well injection for brine disposal.

The advanced purified water treatment strategy would treat only part of the effluent from the two plants. The Haskell Street WWTP would continue to provide treated water to the Ascarete Golf Course. EPWU will continue to meet its contractual obligations to provide a portion of the wastewater that originates as surface water for downstream irrigators. There may be other impacts by reducing the volume or changing the timing of effluent discharges that are not covered by contractual obligations. It is anticipated that this strategy will be implemented by 2040.

Quantity, Reliability, and Cost – For this strategy analysis, it is assumed that the initial capacity of the project would be approximately 2 MGD at each plant location, with the project on-line in 2040. The capacity at each location would be expanded in 3 MGD increments in the years 2050 through 2080, with a final 2 MGD expansion by 2090 for a total combined capacity of 32 MGD (24,000 acre-feet per year). The table below presents the combined capacity by decade within the current water planning cycle.

Combined Haskell and Northwest Plant Capacity by Decade

Decade	Combined Capacity (MGD)
2040	4.0
2050	10.0
2060	16.0
2070	22.0

The conceptual design and cost for the strategy was based on the Bustamante Advanced Purified Water Plant. Project components include additional conventional wastewater treatment to remove nutrients, an advanced treatment facility employing reverse osmosis and other filtration processes, disinfection and storage. Disposal wells and pump stations, assumed to be one-third of the amount treated, were added to expansion phases as needed. The pipeline connections were sized for the ultimate capacity of 16 MGD at each plant.

The capital cost to build the first two plants is approximately $76 million. The combined cost for each 3 MGD expansion ranges from $62 million to $88 million, depending on the need for additional pumping or disposal facilities. Unit costs for each expansion range from $5.83 to $8.90 per 1,000 gallons during debt service. Unit costs after payment of the debt are about $2.25 per 1,000 gallons. The total capital cost for this strategy, which includes all four project phases, is approximately $291.8 million.

E-12 Advanced Purified Water at the Bustamante WWTP

The Roberto R. Bustamante Wastewater Treatment Plant is located in southern El Paso near the community of Socorro. The plant is adjacent to the Jonathan Rogers Water Treatment Plant and the Rio Bosque wetlands. The wastewater plant currently discharges approximately 27 MGD into the Riverside Irrigation canal and 1.5 MGD to reclaimed water “purple pipe” customers as part of the Mission Valley Reclaimed Water Project.

The Bustamante Advanced Purified Water strategy has been studied in detail by ARCADIS. Project components recommended by ARCADIS include additional conventional wastewater treatment at the existing plant to remove nutrients, an advanced treatment facility (microfiltration/ultrafiltration, nanofiltration or reverse osmosis, ultraviolet/advanced oxidation process, activated carbon and chlorine disinfection) and storage. The purified water will be placed directly into the distribution system. Disposal of the waste stream, assumed to be one-third of the amount treated, will be by deep well injection. For this evaluation, costs were added for the necessary connection piping to the distribution system and the disposal well system.

Currently most of the wastewater from the Bustamante WWTP that is not being reused is discharged into a canal system. Much of that water is then used for downstream irrigation, although some of the flow may also serves to maintain environmental functions. Reuse of additional water may impact those functions, but the overall impact is expected to be small.

The Advanced Purified Water strategy will treat only part of the effluent from the Bustamante WWTP. Effluent will continue to be discharged to meet EPWU obligations to downstream irrigators and the needs of purple pipe customers. EPWU will continue to meet its contractual obligations to provide a portion of the wastewater that originates as surface water for downstream irrigators. There may be other impacts by reducing the amount of wastewater that is not covered by contractual obligations.

It is anticipated that this strategy will be implemented by 2020.

This project is part of EPWU's Integrated Water Strategy and as such is inherently related to other EPWU strategies and sources of supply. The availability of water from this strategy is affected by the portion of the treated effluent that originates as surface water, a portion of which is dedicated by contract to downstream irrigators. There may be some reduction in return flows EPWU is not obligated to discharge, but this impact is expected to be small.

Quantity, Reliability, and Cost – This strategy is assumed to provide approximately 8,000 acre-feet per year, expanding to about 10,000 acre-feet per year by 2070. Because of the quantity of wastewater treated at the plant, the supply should be very reliable, even after accounting for the portion of the supply committed to irrigators and "purple pipe" customers. The capital cost for this strategy is estimated at $94 million. The unit cost during debt service is $6.44 per 1,000 gallons. After debt repayment, the unit cost drops to $2.20 per 1,000 gallons.

E-13 Aquifer Recharge with Treated Surface Water

Water treatment plant capacity and the timing of demand for water currently limit the use of surface water by EPWU. Early in the irrigation season, the water available from the Rio Grande exceeds the demand that can be supplied by surface water. Later in the irrigation season, the demand can exceed the treatment plant capacity. In order to make use of the available surface water early in the irrigation season, EPWU plans to develop a facility to recharge the Hueco Bolson Aquifer with treated surface water.

The Hueco Bolson Aquifer is the primary source of water for the City of El Paso, Fort Bliss, Ciudad Juarez and private industries in the area. Since 1903 groundwater levels have declined by as much as 150 feet in some areas of the Aquifer, thus developing a cone-of-depression around a major pumping center serving the City of El Paso. This area is located over an ancient watercourse of the Rio Grande and is well suited for both short- and long-term groundwater storage due to the high porosity and permeability of the de-saturated vertical portion of the Aquifer formation. The substantial depression in the water table surface thus affords ample underground storage space and reasonably high assurances of long-term recovery of stored water. The recharge basin area described in this strategy is in the northern portion of the cone-of-depression and water percolating downward through the basins will naturally gravity drain in the subsurface toward the existing production wells located approximately two miles away.

Previous projects and studies have shown the practicality of aquifer recharge in the El Paso area. The Hueco Bolson Aquifer has been successfully recharged with tertiary treated wastewater from the Fred Hervey Water Reclamation Plant that is treated to drinking water quality standards. Injection rates of up to about 10,000 acre-feet per year through deep injection wells and spreading basins have occurred since the mid-1980s. The average horizontal hydraulic conductivity estimated from 85 EPWU production well pumping tests is 10 meter/day (32.8 feet/day or 2.3 miles/year). An AWWARF funded study (Comparison of Alternative Methods for Recharge of a Deep Aquifer) lists a vertical wetting front velocity of 13.8 feet/day. Aquifer recharge using both treated wastewater effluent and available surface water provide an opportunity to mitigate aquifer overdraft and potentially restore groundwater supplies for continued use.

The treated water strategy will expand the existing recharge basins and supplement the recharge supply with excess treated water from the Jonathan Rogers WTP. This strategy will require approximately 10,000 feet of 20-inch pipe and six new spreader basins for the treated water. It is anticipated that this strategy will be implemented by 2020.

Quantity, Reliability and Cost – This strategy is estimated to provide 5,000 acre-feet of additional supply to EPWU. This supply may only be available when surface water supplies are available. The strategy will be used conjunctively with other sources of water available to EPWU. For costing purposes, it is assumed that the pressure from the distribution system will be sufficient to deliver the water to the spreader basins. No pump station was included in the cost estimate.

Capital costs for this project are estimated at approximately $2.5 million. Annual costs are based on the electricity cost of pumping the water through the new pipeline and the cost of treating the water. Costs of maintaining the spreader basins are not included.

E-14 Treatment of Agricultural Drain Water

The original 2011 *Far West Texas Water Plan* included a strategy to develop two 5 MGD desalination plants at the Rogers and Canal Water Treatment Plants to treat agricultural drain water for municipal use. Since this *Plan,* Hazen and Sawyer, P.C. has completed a study on the treatment of drain water near the Upper Valley Water Treatment Plant using conventional treatment, using blending with other sources to meet water quality standards. This amended strategy proposes using the same combination of conventional treatment and blending at the Rogers and Canal Plants, for the facility at the Upper Valley Plant examined in the Hazen and Sawyer study. For the purpose of this amended *Plan*, this strategy assumes that a 5 MGD plant will be built at the Upper Valley Water Treatment Plant site.

The use of conventional treatment eliminates the need for brine disposal. However, it does require the availability of lower TDS treated water source in sufficient quantity for blending. The Hazen and Sawyer study found that hardness was a controlling factor, along with TDS, in determining blending ratios with treated water from the Upper Valley Plant. Blend ratios varied from approximately 4 to 1 to more than 14 to 1, depending on target water quality. If additional treatment such as desalination becomes necessary, the strategy’s cost estimate will be impacted. New costs may include but not limited to: direct cost of treatment, brine disposal, and reduction in the total yield. These new strategy components will increase the overall project unit cost. It is anticipated that this strategy will be implemented by 2030.

Agricultural drain water may serve some minor environmental functions in the El Paso area, but the overall impact of reducing drain flows should have minimal impacts on the environment. Since the drain water is not used for irrigation purposes, there should be minimal rural or agricultural impacts. Reduced flows in the drains may impact water quality by reducing the available flow to dilute the agricultural runoff. This strategy assumes that the treatment waste stream will most likely be discharged directly into the sewer system with solids going to a landfill.

Quantity, Reliability and Cost – At ultimate development, the total water supply from this project will be approximately 2,700 acre-feet per year. Reliability of the project is medium, since the supply is dependent on the quantity of drain water available as well as having sufficient water from other sources to achieve the desired water quality. Although by itself the water supply from this strategy may not be fully reliable, as part of the Integrated Water Management Strategy a reliable supply will be made available through conjunctive use of this water supply in addition to water from other sources made available to EPWU.

The total capital cost for the water treatment plant is estimated to be approximately $41.6 million, with a unit cost of water during debt service at approximately $5.83 per 1,000 gallons, reducing to approximately $1.73 per 1,000 gallons once the debt has been repaid.

E-15 Expansion of Local Well Fields

EPWU currently obtains fresh groundwater from two well fields: the Hueco Bolson well field and the Canutillo (Mesilla Bolson) well field. EPWU plans to complete 15 to 20 new groundwater wells in these two existing well fields in order to expand production. For the purpose of this *Plan*, this project will seek to develop four wells (two in each well field) in each decade of the planning period. These four wells will yield an additional 3,880 acre-feet per planning decade. Total project yield of this strategy is approximately 19,400 acre-feet over the entire planning horizon. The conceptual design of this strategy includes new wells and all associated equipment. Groundwater supplies from these wells are part of EPWU's Integrated Water Management Strategy and are used conjunctively with supplies from other sources. It is anticipated that this strategy will be implemented beginning in 2020. Pumping from the Canutillo well field can impact flows in the Rio Grande. This impact is monitored by the Bureau of Reclamation. The Bureau may reduce EPWU's surface supplies by the impacted amount.

Quantity, Reliability and Cost – According to EPWU, the cost of drilling and equipping a new well in these well fields is approximately $1 million. For the purpose of this *Plan*, an additional contingency of 35 percent has been added to the cost, as well as allowances for permitting and mitigation, land acquisition, and interest during construction. Annual costs are based on a lift of 600 feet for the Hueco Bolson wells and 400 feet for the Canutillo wells. The total project yield for this strategy is anticipated to be approximately 19,400 acre-feet. This strategy assumes that the total capital cost of the 20 wells is approximately $32.7 million.

E-16 Brackish Groundwater at the Jonathan Rogers WTP

The Rio Grande Alluvium Aquifer has been identified by EPWU as a potential source for the development of additional groundwater supplies. This strategy assumes that 10 new wells will be drilled to provide an additional 11,000 acre-feet per year. The 10 new wells will be connected to a central desalination facility located at or near the Jonathan Rogers Water Treatment Plant. The brine concentrate from the EPWU wells will be disposed of using deep well injection. For planning purposes, a 12-inch diameter, 10-mile brine disposal pipeline was assumed. One 1,000-gpm deep brine injection well was also included. This strategy presumes that most of the new wells and the treatment facility will be developed on property currently owned by EPWU. It is anticipated that this strategy will be implemented by 2040.

Quantity, Reliability and Cost – For this *Plan*, the ten new wells are assumed to be drilled at a depth of 500 feet to provide an additional supply of 11,000 acre-feet per year. Historical municipal, agricultural and industrial use indicates that the Rio Grande Alluvium Aquifer may be a viable source. The reliability of water from this source is expected to be medium to high based on competing demands. The water supply from this strategy is assumed to be part of EPWU's portfolio of sources that are used conjunctively. The total capital cost of this project will be approximately $65.8 million. This cost estimate includes the 10 new wells, associated pipelines, storage, pumps and power, and 8 MGD RO treatment facility, and 10 miles of transmission pipeline to convey brine concentrate to the disposal well. The initial unit cost is approximately $2.85 per 1,000 gallons. Once the debt has been paid, the unit cost decreases to approximately $1.31 per 1,000 gallons.

E-17 Expansion of the Kay Bailey Hutchison Desalination Plant

The Kay Bailey Hutchison Desalination Plant is one of the world's largest inland desalination facilities. The facility, which is a joint project of EPWU and Fort Bliss, currently has the capacity to treat 27.5 MGD of brackish groundwater. Disposal of brine reject from the facility is through deep well injection. The project not only provides a safe and reliable supply for the City of El Paso and Fort Bliss, but it also protects fresh groundwater supplies by intercepting the flow of brackish groundwater toward the fresh water wells. In 2014, the plant provided 9,000 acre-feet of fresh water.

This strategy would expand both the production of brackish groundwater and increase the capacity of the plant to 32 MGD. For planning purposes, it is assumed that this strategy will be implemented in two phases. The first phase includes a new 2.25 MGD expansion at the existing facility, four new source wells and associated piping. It is assumed that EPWU's current disposal facilities are adequate for the first phase. It is anticipated that the first phase of this strategy will be implemented by 2020.

The second phase includes another 2.25 MGD expansion, three new source wells and a new disposal well. For costing purposes, it is assumed that a new parallel pipeline, pump station and storage tank will be needed for the new disposal well. It is anticipated that the second phase of this strategy will be implemented by 2030.

Quantity, Reliability, and Cost – This project will provide additional water supply in EPWU's conjunctive use portfolio. The combination of new wells and another 4.5 MGD of capacity will provide approximately 2,500 acre-feet of water per year. This supply is assumed to be very reliable. However, this project is expected to be one of the more expensive water supply sources available to EPWU, and therefore the facility is not anticipated to be operated fulltime.

The first phase of the project is expected to cost approximately $13.1 million. The initial cost of water is $3.86 per 1,000 gallons. Once the debt has been paid, this cost will decrease to approximately $1.20 per 1,000 gallons.

The second phase is expected to cost approximately $24.1 million. This initial cost of water is $6.37 per 1,000 gallons. Once the debt has been paid off, the unit cost drops to $1.46 per 1,000 gallons. The total estimated project cost is approximately $37.2 million.

E-18 Groundwater from Hueco Ranch

EPWU is proposing developing a new groundwater supply from Hueco Ranch which is located approximately 20 miles east of the City of El Paso. Most of the property is in Hudspeth County, with a small portion in eastern El Paso County. During drought years when surface water supplies are limited, this strategy could produce up to 5,000 acre-feet per year. The source of water for this strategy is not a TWDB named aquifer but rather a localized groundwater formation classified as "Other Aquifer – Diablo Plateau". This source of available groundwater is not managed by a groundwater conservation district.

Static water levels from this water supply range from 650 to 1,000 feet below the ground surface, which coincides with the top of the aquifer. Transmissivity ranges from 50,000 gpd/ft to 200,000 gpd/ft. Initial estimates indicate that the aquifer can produce 20,000 acre-feet per year, but more investigation will be required to confirm the reliability of the supply. For this *Plan*, it is assumed that the project will supply 5,000 acre-feet per year to be implemented by 2040.

The conceptual design for this strategy includes nine new groundwater wells with the required piping, pumping and storage, 19 miles of 24 inch pipeline, a pump station, and treatment. Treatment would consist of, but not be limited to: pre-oxidation, coagulation/sedimentation, granular media filtration and disinfection. This strategy assumes that treatment would occur at the treatment facility prior to blending the supply into the distribution system. For the purpose of this *Plan*, this strategy is assumed to be a stand-alone project. However, it could be developed along with other groundwater import strategies, potentially sharing a pipeline to El Paso. The pipeline would be routed in the right of way of Highway 62/180.

Since the proposed Hueco Ranch groundwater supply is located outside of the active area of an approved groundwater availability model, the potential aquifer impact was evaluated using a Theis drawdown model. The model was assigned the minimum range of aquifer transmissivity (50,000 gpd/ft), and a much more conservative storage coefficient of 0.001. The nine proposed wells were placed in a grid pattern spaced 2,500 feet apart. A constant pumping rate of about 555 acre-feet per year was assigned to each well for total production of 5,000 acre-feet per year from the well field. The model then simulated the well field pumping continuously for 30 years. Results of the simulation indicate that at the Hueco Ranch boundary the simulated water level decline after 30 years is about 45 feet. At 10 miles from the well field the simulated drawdown after 30 years decreases to approximately 30 feet. Importantly, the simulated water level decline is limited to the aquifer in which the wells are completed and does not necessarily affect other aquifers or formations where wells may be completed.

Quantity, Reliability, and Cost – This strategy is expected to produce 5,000 acre-feet per year beginning by 2040. There are no known wells within range of influence of this pumping strategy other than those currently in operation by the Hueco Ranch WSC. Although a thorough pumping test has not been performed at this site, limited pumping tests indicate that this source is sustainable when pumped at the recommended pumping rate.

The total capital cost of this strategy is approximately $156 million. A major portion of the project cost is land acquisition, which is estimated at approximately $52 million. The initial unit cost of the project is $10.16 per 1,000 gallons. After debt service, the unit cost decreases to approximately$2.16 per 1,000 gallons.

E-19 Groundwater from Southern Hudspeth County

EPWU is proposing developing a new groundwater supply as a drought contingency from southern Hudspeth County on State-owned (GLO) properties. This strategy may also be used to provide water supply for other entities in the Lower Valley. For the purpose of this *Plan*, it is assumed that in most years this strategy would produce 3,000 acre-feet per year. During drought years when surface water supplies are limited, this strategy could produce up to approximately 10,000 acre-feet per year. The strategy has identified the Diablo Plateau Cretaceous Aquifer as being a viable source. Since this source is not recognized as a named aquifer by the TWDB, it has been classified for planning purposes as “Other Aquifer – Diablo Plateau”.

It is assumed that at full development of this strategy an additional supply of approximately 10 MGD will be provided. For the purpose of this *Plan*, this strategy will require 65 miles of 24 inch pipeline, 14 one MGD wells and other well field appurtenances such as storage tanks, pumps and electricity. It is anticipated that this strategy will be implemented by 2020.

A groundwater drawdown simulation model (Theis) was used to evaluate the potential effect that this well field might have on adjoining properties. The model was assigned an aquifer transmissivity value of 40,000 gpd/ft and a storage coefficient of 0.01 as a conservative value for the local conditions. The 14 proposed wells were placed in a grid pattern spaced 2,500 feet apart. A constant pumping rate of about 715 acre-feet per year was assigned to each well for total production of 10,000 acre-feet per year from the well field. The model then simulated the well field pumping continuously for 50 years. Results of the simulation indicate that at 10 miles from the well field the simulated drawdown after 50 years is approximately 50 feet. Importantly, the simulated water level decline is limited to the aquifer in which the wells are completed and does not necessarily affect other aquifers or formations where wells may be completed.

Quantity, Reliability, and Cost – The proposed project will be built to produce a maximum capacity of 10,000 acre-feet per year; however, it is anticipated to be operated at only 3,000 acre-feet per year in normal non-drought years. There are relatively few if any currently existing wells in the area of the proposed well field. Modeling indicates that the supply may be viable, but additional testing is necessary.

The total capital cost of this strategy, based on the assumed infrastructure, is expected to be approximately $99 million. The strategy cost estimate includes a GLO Royalty Payment of $250 dollars per acre-foot produced by the project. At full operating capacity of 10,000 acre-feet per year, the initial unit cost of water is $4.50 per 1,000 gallons. At normal operating capacity of 3,000 acre-feet per year the initial unit cost of water is $10.84 per 1,000 gallons. After debt service, the unit cost of water decreases to approximately $1.96 per 1,000 gallons at 10,000 acre-feet per year and $2.37 per 1,000 gallons at 3,000 acre-feet per year.

E-20 Expansion of the Jonathan Rogers Water Treatment Plant

EPWU currently obtains surface water from the Rio Grande in accordance with a series of contracts with EPCWID #1, the U.S. Bureau of Reclamation, and the Lower Valley Water District. These contracts allow the conversion of water allocated for irrigation of lands owned or leased by EPWU into municipal supply. Within the restriction of various contracts, EPWU may acquire irrigated lands in tracts inside the EPCWID #1 boundary within the Rio Grande Project and use the water for municipal supply. As irrigated acreage is converted to urban area, more water will likely be available for acquisition by EPWU. The conversion of water for municipal supply requires contracts or agreements with the U.S. Bureau of Reclamation and EPCWID #1.

This strategy assumes that the increased surface water supply will require additional treatment capacity. Currently, the Jonathan Rogers Water Treatment Plant capacity is 60 MGD. The proposed strategy will increase the capacity to 80 MGD by replacing and enhancing existing treatment facilities. A preliminary design of the plant expansion by CH2M Hill Engineers, Inc. is the basis for the cost estimates for this strategy. It is anticipated that this strategy will be implemented by 2020.

Quantity, Reliability, and Cost – Based on a 7 month irrigation season and assuming a peaking factor of 2, this strategy will provide up to 6,500 acre-feet of treated water per year. The actual quantity of water is dependent on new irrigation properties acquired by EPWU and the availability of surface water from the Rio Grande Project, which varies from year to year. Although by itself the supply from this strategy may not be fully reliable, as part of the Integrated Water Management Strategy a reliable supply will be made available through conjunctive use of this supply with water from other sources available to EPWU.

The estimated total capital cost for this strategy is approximately $95.2 million. The unit cost of water during debt service is $2.76 per 1,000 gallons. Once the debt has been repaid the unit cost decreased to approximately $0.78 per 1,000 gallons. Costs associated with the acquisition of irrigation rights are not included.

E-21 Riverside Regulating Reservoir

Making efficient use of supplies is a key goal of the El Paso area. In order to make more efficient use of surface water supplies, EPWU and the EPCWCID#1 have proposed building a regulating reservoir near the community of Socorro, adjacent to the Jonathan Rogers Water Treatment Plant and the Bustamante Wastewater Treatment Plant. The project will be shared by EPWU and EPCWID#1. The details of this sharing agreement have yet to be determined and are outside the scope of regional water planning.

This proposed strategy site was formerly the location of several wastewater disposal ponds associated with an abandoned wastewater facility. The regulating reservoir strategy will be connected to the Riverside Canal which ultimately receives water from the Rio Grande River. The regulating reservoir will allow more efficient use of stored water releases from the Rio Grande Project, as well as flows that originate as stormwater runoff below Caballo Reservoir. This strategy could minimally reduce flows downstream only during periods when storm runoff and over-ordered irrigation supplies occur. Excess water that cannot be used immediately would be temporarily stored in the reservoir for later use. Currently this water flows back into the Rio Grande. The temporary stored water would be used either for downstream irrigators or be pumped to the nearby Jonathan Rogers Water Treatment Plant for municipal use. These water sources are already authorized through existing state and federal contracts, agreements and water rights. Storing water in the project may require amendments to some of these authorizations.

Portions of the project have already been completed, including improvements to the Riverside Franklin Feeder Check Structure; - a concrete bridge to the Jonathan Rogers WTP; - canal lining; and a flood waste-way to the river. The remaining facilities include:

- A 4,100 acre-foot ring levy regulating reservoir
- Improved inlet to Jonathan Rogers WTP and check structure
- Dual 60" RCP inlet connecting the Riverside Canal to the regulating reservoir
- Dual 12' x 8' radial gate outlet for releases from the regulating reservoir
- Concrete lining 400' downstream of outlet from the reservoir

- Raw water supply pump and bay
- 9,400 feet of 36" PVC raw water line connecting reservoir to WTP

The regulating reservoir will be built on approximately 320 acres that contain abandoned wastewater treatment ponds. The strategy site is not currently used for any purpose and does not provide significant habitat. The most direct route for the pipeline from the regulating reservoir to the Jonathan Rogers Water Treatment Plant would be between the Rio Bosque wetlands and the Rio Grande. Further investigation and possible re-routing may be required to evaluate potential impacts to the wetlands. The constructed reservoir could provide beneficial habitat for birdlife.

Quantity, Reliability, and Cost – The primary benefit of this strategy is allowing for more efficient use of existing supplies of water. Previous studies of this project have estimated that the project could provide 6,500 acre-feet of water per year. However, there may be some years where the strategy could provide more or less water, depending on available river supplies and the availability of unneeded water in the canal. Although by itself the supply from this strategy may not be fully reliable, as part of the Integrated Water Management Strategy a reliable supply will be made available through conjunctive use of this supply with water from other sources available to EPWU and EPCWID#1.

The estimated total capital cost of this project is approximately $20.8 million. Assuming a water-supply of 6,500 acre-feet per year, the unit cost of the water is $300 per 1,000 gallons during debt service. Once the debt has been paid, the unit cost will decrease to approximately $73 per 1,000 gallons.

E-22 Groundwater from Diablo Farms

The Capitan Reef Aquifer is recognized as a minor aquifer by the TWDB. In 2003 and 2004, EPWU purchased about 28,000 acres of land (Diablo Farms) overlying the Capitan Reef Aquifer. The property straddles the Hudspeth and Culberson County lines adjacent to the Salt Basin southeast of Dell City. Recharge estimates for this portion of the Capitan Reef range from 10,000 to 20,000 acre-feet per year. TDS concentrations in the area range from 850 to 1,500 mg/L. All the currently operating irrigation wells on Diablo Farms have TDS values below 1,000 mg/L. However, it is expected that significant increases in pumping amounts would result in movement of poorer quality groundwater into the area.

EPWU has completed preliminary evaluations of groundwater availability in the area, and has concluded that pumping less than 10,000 acre-feet per year would not require desalination. Pumping between 10,000 and 25,000 acre-feet per year would not result in mining of the Aquifer, but the groundwater would likely have to be desalinated over time as the intrusion of poorer quality water into the well field area increases salinity. These estimates are preliminary, and are subject to confirmation after additional monitoring and tests. Ideally, any development would be completed in phases such that responses to pumping in terms of groundwater level changes and groundwater quality changes could be used to refine and modify future phases. Importation of 10,000 acre-feet per year from the Capitan Reef Aquifer is proposed by 2050.

EPWU owns Diablo Farms above the Capitan Reef Aquifer and, until the construction phase is started, the land will continue to be used for agricultural purposes. The eventual discontinuation of irrigated farming on this property will impact only a minor number of agricultural jobs. Workers needed to operate and maintain the well field would replace these agricultural jobs. The conversion of cultivated land associated with the well field to native rangeland may benefit some wildlife species; however, the loss of a food source (grain crops, etc.) may be detrimental to other species.

Quantity, Reliability, and Cost – The proposed strategy calls for production of up to 10,000 acre-feet per year from this source. At this level of production, water from this source is expected to be very reliable. For the purpose of this *Plan*, it is assumed that the transmission facilities for this project would be shared by with the Dell City groundwater strategy, and that the Diablo Farms project will be built first. A portion of the pipeline has sufficient capacity to carry the volume of water at full development of both projects (10,000 acre-feet per year from Diablo Farms and 20,000 acre-feet per year from Dell City). EPWU already owns the property at Diablo Farms, so land acquisition is limited to pipeline right-of-way. It is assumed that a 100 foot right-of-way would be purchased to allow for parallel pipelines. Using these assumptions, the capital cost of the project is approximately $273.5 million. The initial unit cost is $8.52 per 1,000 gallons. Once the debt has been paid, the unit cost drops to $1.50 per 1,000 gallons.

E-23 Groundwater from Dell City Area

Groundwater from the Dell City area has been part of the *Far West Texas Water Plan* since 2006. This strategy includes obtaining water rights, construction of a pipeline to El Paso, and a desalination facility. This project may be developed in two phases and in conjunction with the Diablo Farms groundwater import strategy.

Dell City is located approximately 75 miles east of El Paso, near the New Mexico-Texas border. The Bone Spring-Victorio Peak Aquifer covers 130 square miles in Texas near Dell City. The Hudspeth County Underground Water Conservation District No.1 (HCUWCD #1) regulates groundwater pumping in this area. Management of the Aquifer by HCUWCD #1 is governed by the District's rules and groundwater management plan. According to the management plan, the modeled available groundwater (MAG) for the Aquifer is 101,400 acre-feet per year assuming an irrigation return flow of 30 percent. The net pumping (pumping without return flow) that achieves the desired future conditions (DFC) for the Aquifer is 71,000 acre-feet per year.

The rules of the District outline a permitting system for the purpose of conserving, preserving, protecting, and recharging groundwater in the District. Holders of permits pump groundwater based on a "Water Allocation", which is expressed in terms of acre-feet per acre. The amount of the allocation is adjusted every two years based on the groundwater elevation in a monitoring well. There are four types of permits:

- Drilling Permits are granted for the drilling of production or monitoring wells, or an existing well that needs to be re-drilled.
- Validation Permits are granted for existing and historical uses.
- Operating Permits are granted for pumping where no Validation Permit exists.
- Transfer Permits are granted for uses outside the District boundaries, and require an Operating Permit prior to issuance.

For Validation Permits for irrigation, the following "Water Allocation" limits are then applied based on the groundwater level in the well:

- If the groundwater elevation is greater than 3,570 feet above mean sea level, the Water Allocation is 4.0 acre-feet/acre.
- If the groundwater elevation is between 3,565 and 3,570 feet, the District Board, by resolution, may establish a Water Allocation on a pro-rata basis between 3.0 and 4.0 acre-feet/acre.
- If the groundwater elevation is below 3,560 feet, the Water Allocation is 3.0 acre-feet/acre.

Operating permits, which are granted when there is no historical existing use, are allocated only if the groundwater elevation is above 3,580 feet. Above 3,580 feet the Water Allocation is 0.5 acre-feet per acre. This amount may be increased on a pro rata basis if Validation Permits are in "Suspended Lands" status. Suspended Lands status occurs when Validation Permit holders voluntarily reduce groundwater production by removing property from irrigated agriculture. Transfer of water is limited to the groundwater production authorized under the Operating Permit.

Water from this source has concentrations of iron, chloride, nitrate, sulfate, and aluminum exceeding water quality standards for municipal supply. Total dissolved solids in the Dell City area range from 1,810 to 3,900 mg/L. As a result, desalination would be required before distribution for municipal use.

This strategy assumes an additional supply of 10,000 acre-feet per year beginning in 2060 and increasing to 20,000 acre-feet per year by 2070. The first phase of the project includes rehabilitation of seven wells plus one contingency well with accompanying pumps, pipelines and other appurtenances, a pump station, 12 miles of 42-inch pipeline, expansion of the existing pump stations on the Diablo Farms to El Paso pipeline, and a 18 MGD desalination facility with disposal wells. The water from the desalination facility will be blended with untreated water to produce the desired water quality. The total capital cost of Phase I is $195 million. A substantial portion of the cost of this project is the purchase of property in the Dell City area, which is assumed to be approximately $55 million for this first phase.

Phase II of the project adds rehabilitation of eight more wells with the associated facilities, another expansion of the pump stations on the pipeline to El Paso, and a 18 MGD expansion of the desalination facility. Also included is $55 million for purchase of additional property, for a total of $110 million between the two phases. The capital cost of Phase II is $108 million. Initial unit cost of water is $4.82 per 1,000 gallons, reducing to $2.75 when the debt has been paid. Importation of 10,000 acre-feet per year from the Bone Spring-Victorio Peak Aquifer is proposed by 2060.

Aquifer withdrawals from the Bone Spring-Victorio Peak Aquifer at the proposed pumping rates for this strategy are at a sustainable level based on the current rules of the Hudspeth County Underground Water Conservation District No.1. Municipal transfer pumping would replace an equal amount of agricultural pumping, and therefore, no net increase of pumping would occur. The conversion of cultivated land to native rangeland that is associated with new well fields may benefit some species, however; the loss of a food source (grain crops, etc.) may be detrimental to other species.

Quantity, Reliability, and Cost – For the purpose of this *Plan*, it was assumed that the proposed importation from Dell City would begin in 2060 (10,000 acre-feet per year) and rise to 20,000 acre-feet per year by 2070. It is assumed that the Diablo Farms well field will be developed first, and this project will share transmission facilities to El Paso. For this *Plan*, it is assumed that the Diablo Farms strategy would be implemented first. Most of the cost of the pipeline to El Paso has been included in that strategy. Water from this source is expected to be reliable when operated conjunctively with other sources of water available to EPWU. The total capital cost of both phases is $303 million. For the entire project, the initial unit cost of water is $6.59 per 1,000 gallons. Once the debt has been paid, the unit cost of water is $2.70 per 1,000 gallons.

5A.6 WATER MANAGEMENT STRATEGIES FOR THE LOWER VALLEY WATER DISTRICT

The Lower Valley Water District (LVWD) is located in the southeastern portion of El Paso County and currently offers water, wastewater and solid waste services to residents within a distribution system of 210 square miles east of the City of El Paso city limits. The City of Socorro, the community of San Elizario, the Town of Clint, El Paso County Sparks Addition, Sand Hills and other El Paso County Colonias are located within the LVWD's boundaries. The LVWD's sole source of water is purchased from the combined (blended) EPWU sources developed in the previously described EPWU Integrated Strategy. The LVWD is proposing several new sources of water that will help limit the supplies delivered by EPWU to roughly current levels, and obtain additional supply needed for growth independently.

The LVWD has a projected water-supply deficit of 2,453 in 2020 increasing to 6,227 by 2070. The following water management strategies are recommended to enhance the reliability of the LVWD's future water supply availability:

- (E-24) Public conservation education
- (E-25) Purchase water from El Paso Water Utilities (EPWU)
- (E-26) Surface water treatment plant and transmission line
- (E-27) Groundwater from proposed well field – Rio Grande Alluvium Aquifer
- (E-28) Groundwater from proposed well field – Hueco Bolson Aquifer
- (E-29) Wastewater treatment facility and ASR

The TWDB requires that water management strategies develop new water 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 here: https://www.twdb.texas.gov/financial/index.asp. The LVWD has the following active projects, which do not meet the SWIFT requirements, but are currently being funded through other financial measures offered by the TWDB.

- Collection system extensions
- Water main replacement

E-24 Public Conservation Education

The LVWD is encouraged to emphasize conservation through public information programs. A total of one percent reduction in demand is anticipated, which would result in a water savings of 35.74 acre-feet per year in 2020; increasing to 73.48 acre-feet per year in 2070. The annual cost for implementing a public information conservation program is estimated at $30,456 in 2020; increasing to $33,826 in 2070.

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 BMPs that might be encouraged is available in *TWDB Report 362, Water Conservation Best Management Practices Guide.*

E-25 Purchase Water from El Paso Water Utilities (EPWU)

The LVWD has historically purchased its water supply from EPWU and furnishes this supply to its wholesale customers. This strategy provides for the purchase of additional water supplies from EPWU to meet the projected future supply needs of its customers. The purchased supply is reliant on EPWU maintaining its blended water supply and implementation of its Integrated Strategies (5A.5).

This strategy assumes that LVWD would purchase an additional 2,453 acre-feet per year of water by 2020 and increasing amounts in following decades from EPWU at a cost of $436 per acre-foot. The annual cost for the water purchase is $1,070,000. See EPWU strategies (Section 5A.5) and Tables 5-2 and 5-4 for anticipated new strategy implementation impacts.

E-26 Surface Water Treatment Plant and Transmission Lines

The only potential surface water source in the area is the Rio Grande and canals that divert water from the Rio Grande upstream of El Paso wastewater discharges. Currently, the Rio Grande in the vicinity of the LVWD contains a large percentage of wastewater discharges, originating from both the City of El Paso and the Mexican City of Juarez. The most feasible surface water supply alternative to the LVWD is to build an intake on the American Canal upstream of EPWU's intake for the Jonathan Rogers WWTP. This strategy assumes that the LVWD and the El Paso County WID #1 come to an agreement to deliver the water to the proposed intake location. Furthermore, this strategy assumes that the LVWD will hold all necessary future Rio Grande Project (RGP) leased water rights. In addition, the LVWD will need to inform EPWU that they will be providing their own supplemental water supplies in the future. The obligation of EPWU to provide water via the Jonathan Rogers WWTP would be limited to the pro rata share of the plant capital costs paid by the LVWD. From that point on, future RGP water rights obtained via lease from agricultural properties would not be traded to EPWU, but rather the LVWD would utilize them directly. This source is currently used for agricultural purposes, and thus this strategy will reduce the amount of water currently available to agricultural users. It is assumed that the transfer of water rights will be between a willing buyer and a willing seller, and therefore minimal impacts to agricultural users is anticipated.

This strategy assumes that the surface water supplies are only available seasonally, and therefore water will only be provided during the summer period (approximately March through October). The LVWD will need to either purchase water from EPWU during the winter months or utilize a groundwater supply source or construct an Aquifer Storage and Recovery (ASR) project to provide the balance of supplies needed to meet future system demands.

The Surface Water Treatment Plant and Transmission Lines Strategy has been studied in detail by the LVWD. Project components recommended by LVWD include the purchase of 100 acres, construction of a new intake on the American Canal, as well as a 10 MGD water treatment plant, pump station able to produce at least 165 HP, and conveyance lines 24-inches in diameter and approximately 10,500 feet in length to transport water from the canal to the SWTP and on to the distribution system. Exact locations for these facilities are presently undetermined. Engineering preliminary studies are recommended to determine the best location for these facilities. It is anticipated that the new treatment plant will be designed to treat approximately 10 MGD, and be similar in design to the Jonathan Rogers SWTP as it is important to produce water that is not significantly different in pH or corrosiveness in order to blend well with EPWU water.

Quantity, Reliability, and Cost – For this *Plan,* it is assumed that this strategy will supply an additional 6,700 acre-feet per year of treated water. The proposed plant has a maximum operating capacity of 10 MGD, assuming it operates year round at full capacity. However, the design is for the plant to only provide water during the summer period (approximately March through October). Therefore, the total capacity volume was reduced by half. The new supply will go directly into customer distribution. The reliability of this project is medium to high depending on available river supplies. The total estimated capital cost for this strategy is $34,080,000.

E-27 Groundwater from Proposed Well Field – Rio Grande Alluvium Aquifer

In order for the LVWD to provide a balance of supplies needed to meet future system demands, the Surface Water Treatment Plant Strategy mentioned above will operate in conjunction with a groundwater project. Several groundwater supply sources are being considered by the LVWD in order to acquire water supply for the four months surface water is not available. Groundwater production in the Rio Grande Alluvium Aquifer is one alternative and is discussed in more detail below. The other option is to develop groundwater supplies in the Hueco Bolson Aquifer (see strategy E-28).

The LVWD has studied in detail the feasibility of developing groundwater from the Rio Grande Alluvium Aquifer for a proposed new well field. This strategy includes the cost for wells, pumps, well field collection lines and land. Annual operation and maintenance costs include well pumping costs, annual maintenance and chlorination. Since the Rio Grande Alluvium Aquifer is high in total dissolved solids (TDS), advanced treatment will be required for municipal purposes.

For this *Plan,* it is assumed that the well field will produce a supply of 10 MGD. A desalination facility (8.3 MGD) utilizing deep well injection (1.5 MGD) for concentrate disposal will be required. It is recommended that the location of the well field be close to the existing distribution system to reduce the costs of transmission line. Costs to transport the water from the well field to the distribution system have not been included in this analysis, as the location of the well field is still unknown. This strategy also includes a 2 MGD ground storage tank and the purchase of 80 acres of land for the plant and another 280 acres for the well field.

This strategy assumes 7 new wells with approximately 2,200 feet of well spacing will be drilled to produce water from 150 feet below the surface. Each water well will have a capacity of approximately 1,000 gpm. The design of the well field is to operate in conjunction with the Surface Water Treatment Plant Strategy E-26 during the winter period when surface water is limited.

Quantity, Reliability, and Cost – The quantity and reliability of water from this source is expected to be approximately 7,000 gpm. For this *Plan,* the 7 new wells, if in operation twelve months out of the year, are expected to supply an additional 11,200 acre-feet per year of water. However, the LVWD is proposing to use this strategy in conjunction with the Surface Water Treatment Plant Strategy E-26, only during the winter period when the availability of surface water is limited. The supply yield during this designated period of production will provide an additional supply of approximately 6,800 acre-feet per year.

Capital costs for public supply wells completed in the Rio Grande Alluvium Aquifer are based on 1,000 gpm wells with 16-inch production casing, drilled to an average total depth of 150 feet, pumping equipment and site improvement. The estimated capital cost for a single well completed in this Aquifer is $140,000.

The Rio Grande Alluvium Aquifer has shown that it can be considered reliable as a water supply if properly developed and is not compromised by additional water demands. This strategy could potentially compete for groundwater that at times is used for agricultural purposes; however, the aquifer is currently being used at less than sustainable capacity.. The total estimated capital cost for this project is approximately $37,490,000, with an annual operations and maintenance cost of approximately $410,000.

E-28 Groundwater from Proposed Well Field – Hueco Bolson Aquifer

Production from a well field completed in the Hueco Bolson Aquifer is a second groundwater alternative being considered by the LVWD as a feasible strategy to help supplement the proposed Surface Water Treatment Plant Strategy E-26. In winter, surface water supplies cannot provide the water supply needed to accommodate the growing water demands. To acquire water supply for the four months surface water is not available, the LVWD has studied in detail the feasibility of developing a new well field in the Hueco Bolson Aquifer.

This strategy assumes 7 new wells with approximately 2,500 feet of well spacing will be drilled to produce water from 650 feet below the surface. Each water well will have a capacity of approximately 1,000 gpm. The design of the well field is to operate in conjunction with the Surface Water Treatment Plant Strategy E-26 during the winter period when surface water is limited.

For this *Plan,* it is assumed that the well field will produce a supply of 10 MGD. A desalination facility (8.3 MGD) utilizing deep well injection (1.5 MGD) for concentrate disposal will be required. It is recommended that the location of the well field be close to the existing distribution system to reduce the costs of transmission line. Costs to transport the water from the well field to the distribution system have not been included in this analysis, as the location of the well field is still unknown. This strategy also includes a 2 MGD ground storage tank and the purchase of 80 acres of land for the plant and another 360 acres for the proposed well field.

Quantity, Reliability, and Cost – The quantity of water from this source is expected to be approximately 7,000 gpm. For this *Plan,* the 7 new wells, if in operation twelve months out of the year, are expected to supply an additional 11,200 acre-feet per year of water. However, the LVWD is proposing to use this strategy in conjunction with the Surface Water Treatment Plant Strategy E-26, only during the winter period when the availability of surface water is limited. The supply yield during this designated period of production will provide an additional supply of approximately 6,800 acre-feet per year.

The capital costs associated with this strategy are based on a 1,000 gpm wells with 16-inch production casing drilled to an average total depth of 650 feet, pumping equipment and site improvement. The estimated capital cost for a well completed in the Hueco Bolson is approximately $390,000. Production from the Hueco Bolson is more expensive compared to the Rio Grande Alluvium due to the increased capital costs required for deeper wells, increased pumping costs, and the increased costs associated with pumping from a confined aquifer.

The Hueco Bolson 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 $41,070,000, with an annual operations and maintenance cost of approximately $7,960,000.

E-29 Wastewater Treatment Facility and ASR

To provide the balance of supplies needed to meet future system demands, along with strategies E-26, E-27 and E-28), the LVWD is also considering the possibility of constructing a wastewater treatment facility and an aquifer storage and recovery (ASR) project similar to the City of El Paso's Fred Hervey Water Reclamation Plant and aquifer recharge project. The concept of this strategy is to tertiary treat wastewater to near drinking-water standards, inject specified volumes into the distribution system, and store the surplus amount into the Hueco Bolson Aquifer for later recovery.

There are three potential sources of water that could be stored and recovered in the ASR project: (1) excess treated surface water (strategy E-26); (2) treated wastewater provided by EPWU; or (3) excess LVWD treated wastewater. The first option would include pumping water from the American Canal at a rate equivalent to taking the full 6.8 MGD over eight months instead of the twelve and deposit the excess in the ASR for use in the winter. The second option would require that EPWU modify its treatment train to produce water to a quality suitable for ASR. The third option requires the LVWD build its own wastewater treatment facility. It is recommended that additional studies be conducted to better determine the feasibility of each of these options. The Hueco Bolson Aquifer is considered as the ASR repository as it has more potential storage volume and is less subject to outside pumping that might pirate a portion of the injected supply. However, the Rio Grande Alluvium may also be an option for the ASR if the Hueco Bolson is determined to be infeasible.

For the purpose of this *Plan*, the third option is chosen for consideration in this strategy and thus considers the construction of a new 3 MGD tertiary wastewater treatment facility, an ASR facility consisting of two 650-foot wells capable of both injection and withdrawal, and 5,280 feet of 12-inch diameter well field piping.

Quantity, Reliability, and Cost – The strategy assumes that an estimated 3,808 acre-feet per year of treated water will be injected into the Hueco Bolson Aquifer. The total capital cost is approximately $18,108,000. Reuse of existing supplies makes this treated supply reliable.

5A.7 WATER MANAGEMENT STRATEGIES FOR THE CITY OF SOCORRO

The City of Socorro is located in the middle of the West Texas portion of the Mission Valley Trail. East of the City lies the San Elizario Mission, and to the west is the Ysleta Mission. This once quiet community of settlers experienced a large growth in population during the 1960s and 1970s with the development of numerous colonias. The Socorro population continues to grow with a projected population reaching 37,031 in 2020 increasing to 60,803 by 2070. The City of Socorro obtains their water supply by purchasing water from the Lower Valley Water District (LVWD). The City has a projected water supply deficit of 217 in 2020; increasing to 1,732 by 2070. The following water management strategies are recommended to enhance the reliability of the City's future water supply availability:

- (E-30) Public conservation education
- (E-31) Purchase water from Lower Valley Water District (LVWD)

E-30 Public Conservation Education

The City of Socorro is encouraged to emphasize conservation through public information programs. A total of one percent reduction in demand is anticipated, which would result in a water savings of 32 acre-feet per year in 2020; increasing to 47 acre-feet per year in 2070. The annual cost to implement a public information conservation program is estimated at $29,625 in 2020; increasing to $48,642 in 2070.

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 BMPs that might be encouraged is available in *TWDB Report 362, Water Conservation Best Management Practices Guide.*

E-31 Purchase Water from Lower Valley Water District (LVWD)

The City of Socorro is serviced by the LVWD which receives its supply from EPWU. This strategy assumes that the City of Socorro will purchase an additional 217 acre-feet per year of water by 2020 from LVWD, at a cost of $436 per acre-foot with a total annual cost of approximately $95,000. The purchased supply is reliant on EPWU maintaining its blended water supply and implementing its Integrated Strategies (5A.5).

5A.8 WATER MANAGEMENT STRATEGIES FOR HORIZON CITY

Horizon City is approximately 20 miles southeast of the City of El Paso. This growing community has a population projected at 28,607 in 2020; increasing to 84,851 by 2070. The City purchases their water supply from Horizon Regional Municipal Utility District which obtains groundwater from the Hueco Bolson Aquifer and Rio Grande Alluvium Aquifer. Horizon City has a projected water supply deficit of 1,352 in 2020; increasing to 9,853 by 2070. The following water management strategies are recommended to enhance the reliability of the City's future water supply availability:

- (E-32) Public conservation education
- (E-33) Purchase water from Horizon Regional MUD

E-32 Public Conservation Education

Horizon City is encouraged to emphasize conservation through public information programs. A total of one percent reduction in demand is anticipated, which would result in a water savings of 45 acre-feet per year in 2020; increasing to 130 acre-feet per year in 2070. The annual cost of implementing a public information conservation strategy is estimated at $22,886 in 2020; increasing to $67,881 in 2070.

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 BMPs that might be encouraged is available in *TWDB Report 362, Water Conservation Best Management Practices Guide.*

E-33 Purchase Water from Horizon Regional MUD

This strategy is dependent on water purchased from Horizon Regional MUD. Horizon Regional MUD obtains water from brackish groundwater supplied from wells in the Rio Grande Alluvium Aquifer, which is desalinated through a 6.0 MGD plant, and from wells in the Hueco Bolson Aquifer that do not require desalination. Section 5A.9 following provides strategies for Horizon Regional MUD water management strategies.

This strategy assumes that Horizon City would purchase an additional 1,352 acre-feet per year of water from Horizon Regional MUD by 2020, at a cost of $436 per acre-foot. The total annual cost for the water purchase is approximately $589,000.

5A.9 WATER MANAGEMENT STRATEGIES FOR HORIZON REGIONAL MUNICIPAL UTILITY DISTRICT (MUD)

The Horizon Regional MUD's mission is to provide affordable, high quality drinking water and environmentally sound wastewater treatment and disposal. The Utility District operates a state-of-the-art reverse osmosis water treatment plant servicing residents within an area of approximately 91,000 acres. The District relies on the Hueco Bolson Aquifer and the Rio Grande Alluvium Aquifer for its municipal water supply needs. Drawing from the Rio Grande Alluvium Aquifer, the District converts brackish groundwater into six million gallons of drinking water per day. The District has plans to expand production by an additional two million gallons per day.

Horizon Regional MUD has a projected water supply deficit of 1,233 in 2020; increasing to 7,451 by 2070. The following water management strategies are recommended to enhance the reliability of the Utility District's future water supply availability:

- (E-34) Public conservation education
- (E-35) Drill additional wells and expansion of desalination plant

E-34 Public Conservation Education

Horizon Regional MUD is encouraged to emphasize conservation through public information programs. A total of one percent reduction in demand is anticipated, which would result in a water savings of 37 acre-feet per year in 2020; increasing to 99 acre-feet per year in 2070. The annual cost for implementing a public information conservation program is estimated at $18,336 in 2020; increasing to $34,417 in 2070.

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 BMPs that might be encouraged is available in *TWDB Report 362, Water Conservation Best Management Practices Guide.*

E-35 Additional Wells and Expansion of Desalination Plant

Brackish groundwater is supplied from wells in the Rio Grande Alluvium Aquifer and is desalinated through a 6.0 MGD plant. The MUD also has wells in the Hueco Bolsons Aquifer that do not require desalination. The Horizon Regional MUD will require additional infrastructure to produce the needed supply in the decade beginning in the year 2020. This strategy assumes that 5 additional wells will be drilled in the Rio Grande Alluvium and 4 in the Hueco Bolsons Aquifer to produce a total of 17,304 acre-feet per year. The 5 wells in the Rio Grande Alluvium will need to be drilled at approximately 150 feet below the surface. The 4 wells in the Hueco Bolsons Aquifer will be produced at a depth of 500 feet. These wells combined are anticipated to have an average capacity of 1,200 gpm. It is assumed that this project will be implemented in two phases. The first set of wells in the Hueco Bolsons Aquifer will be implemented in 2020. The second well field is anticipated to come on-line in 2050 in order to meet the growing water demands. This strategy also includes expanding the desalination plant from the 6.0 MGD to 21.4 MGD.

Quantity, Reliability, and Cost – The groundwater source will continue to be brackish and will be converted to fresh quality through the desalination facility. There is a significant quantity of brackish quality water in the Rio Grande Alluvium Aquifer; therefore, the source is considered very reliable. The capital cost for this project is estimated at $56,443,000 with an annual cost of $11,320,000. Since this strategy relies on brackish supplies that are only occasionally used for agricultural irrigation users, competition for the water is expected to be minimal.

5A.10 WATER MANAGEMENT STRATEGIES FOR FORT BLISS

Located in El Paso County, Fort Bliss is home to the 1st Armored Division, which returned to U.S. soil in 2011, after 40 years in Germany. Fort Bliss is comprised of approximately 1.12 million acres of land in Texas and New Mexico. As the United States gradually came to master the art of building and operating missiles, Fort Bliss became more and more important to the country, and expanded accordingly. Fort Bliss has a projected population of 8,929 in 2020; increasing to 10,531 by 2070. Water supply needs are met partly by purchasing from EPWU's blended source water supplies, along with self-supplied groundwater from the Hueco Bolson Aquifer. Fort Bliss is a cooperator in the construction and operation of the Kay Bailey Hutchison Desalination Facility and receives water from the operation of the plant.

Fort Bliss has a projected water supply deficit of 50 acre-feet in 2020; increasing to 100 by 2070. The following water management strategies are recommended to enhance the reliability of the Military Base's future water supply availability:

- (E-36) Public conservation education
- (E-37) Purchase water from El Paso Water Utilities (EPWU)

E-36 Public Conservation Education

Fort Bliss is encouraged to emphasize conservation through public information programs. A total of one percent reduction in demand is anticipated, which would result in a water savings of 16 acre-feet per year in 2020; increasing to 19 acre-feet per year in 2070. The annual cost for implementing a public information conservation program is estimated at $18,702 in 2020; increasing to $19,230 in 2070.

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 BMPs that might be encouraged is available in *TWDB Report 362, Water Conservation Best Management Practices Guide.*

E-37 Purchase Water from El Paso Water Utilities (EPWU)

Fort Bliss has historically purchased a portion of its water supply from EPWU. This strategy provides for the purchase of additional water supplies from EPWU to meet its projected future supply needs. The purchased supply is reliant on EPWU maintaining its blended water supply and implementation of its Integrated Strategies (5A.5). This strategy assumes that Fort Bliss would purchase an additional 26 acre-feet of water by 2020; increasing to 228 acre-feet by from EPWU at a cost of approximately $340 per acre-foot. The total annual cost for the largest volume of water purchased by 2070 is approximately $78,000.

5A.11 WATER MANAGEMENT STRATEGIES FOR EL PASO COUNTY TORNILLO WID

The township of Tornillo is an unincorporated community in El Paso County with a current population of 3,400 people and has been designated as a "Colonia". The El Paso County Tornillo Water Improvement District provides water services to approximately 947 connections, mostly residential, within the community. The District is self-supplied and relies on the Hueco Bolson Aquifer for municipal water supply needs. Recent data analysis and computer modeling indicate that the Hueco Bolson Aquifer can continue to be sustainably developed well beyond previous estimates.

Although the supply-demand analysis does not project a future water supply deficit for El Paso County Tornillo WID, the following water management strategies are recommended to enhance the reliability of the District's future water supply availability:

- (E-38) Additional groundwater well and transmission line
- (E-39) Arsenic treatment facility

In addition to the above recommended water management strategies, the following water conservation management measures are suggested:

- Provide public with conservation information
- Promote Best Management Practices (BMPs) for residential and commercial water customers

The TWDB requires that water management strategies develop new water 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 here: https://www.twdb.texas.gov/financial/index.asp. El Paso County Tornillo WID has the following project currently being funded through the TWDB's Clean Water State Revolving Fund (CWSRF).

- Planning, design and construction of a collection system to serve local residential subdivisions

E-38 Additional Groundwater Well and Transmission Line

The District with support from El Paso County received funding to construct a new well in the Hueco Bolson Aquifer, which was completed and online by the end of 2010. The District is expecting to need an additional well by 2040 to meet local population growth. Water produced from these wells will be included in the arsenic treatment process upon completion of the treatment facility.

This strategy assumes the development of one new well at a depth of 400 feet. The well is assumed to be operating at a capacity of 310 gpm. In addition, this strategy includes 0.25 miles of 6-diameter transmission line. Minimal treatment, such as chlorine disinfection, will be required for municipal purposes.

Quantity, Reliability, and Cost – For this *Plan*, it is assumed that this strategy will yield an additional water supply of 333 acre-feet per year. Reliability of this source is high due to the Hueco Bolson Aquifer being a prolific aquifer. Modeling indicates that the Aquifer can be sustainably developed beyond previous estimates. The estimated total capital cost for this project is $1,726,000. Development of Hueco Bolson groundwater may have a minor impact on other wells used for agricultural and rural purposes.

E-39 Arsenic Treatment Facility

In 2005, El Paso County Tornillo WID received an alert from TCEQ for future arsenic exceedance. The District obtained funding from the TWDB Drinking Water State Revolving Fund (DWSRF) for the design and construction of a treatment facility to effectively guarantee compliance with the new arsenic regulation. Upon completion, the new facility will treat raw Hueco Bolson Aquifer water from existing wells to provide acceptable water to Tornillo residents.

Funds were used to plan and design a filtration system to meet arsenic standards. During the design phase the District found it necessary to expand the project and could not afford an additional loan. Should funds become available they hope to construct the system through the Economically Distressed Areas Program (EDAP).

The facility is anticipated to be constructed at the existing Well #3 site and will consist of a coagulation / oxidation / filtration process with a full well pumping capacity of 560 gpm. To provide acceptable distribution capacity, new 350 gpm pumps will be placed in Wells #2 and #3. Spent backwash water will be discharged into the existing sanitary sewer system, where it will be treated by the existing 0.75 MGD wastewater treatment plant. Once funded, the project is expected to be completed within eight months following Notice to Proceed.

Quantity, Reliability, and Cost – The estimated total capital cost of this project is $3,114,000, with an annual cost of $622,000. This amount is derived from taking the 2008 TWDB loan application cost and updating it to the 2013 dollar amount using the TWDB Costing Tool. Two wells are currently in use and are alternately pumped on 12-hour cycles to produce a combined 89,900,000 gallons (276 acre-feet) annually. No increase in water quality degradation is anticipated. The project service area was the subject of an earlier Environmental Assessment in which a *Finding of No Significant Impact* was issued in 1997. At a pumping rate of 350 gpm, some local water-level decline may be anticipated; however, the pumping rate is anticipated to be sustainable for the foreseeable future. The wells are located within the boundary of the community of Tornillo, thus the potential water-level decline would be relatively localized.

5A.12 WATER MANAGEMENT STRATEGIES FOR THE CITY OF VINTON

The City of Vinton is an incorporated community in El Paso County with a current population of approximately 2,000 people. This population is projected to increase to 2,443 by 2070. This growing community, nestled between the Rio Grande and the majestic Franklin Mountains, is located along IH-10 north of the City of El Paso.

A marginal segment of the City purchases water from EPWU, whose blended source provides water not only to this portion of the City of Vinton, but also to many other surrounding communities and is described in this *Plan* as the EPWU Integrated Strategy (5A.5).

For almost half a century, this community has lacked a public water supply. The City owns no water rights to the Rio Grande that runs through town, and so residents rely on a questionable patchwork of local and private water companies that draw from groundwater wells. In December of 2013, a group of researches and students from the University of Texas at El Paso confirmed that Vinton's water supply is not safe. Tap water samples from dozens of households tested positive for bacteria like E. coli along with alarmingly high levels of arsenic and salts. Since the community has no sewer service, most houses have septic tanks that are not maintained, allowing for wastewater to seep into the groundwater being pumped for drinking purposes.

Engineers and scientists have recommended for decades that the City of Vinton connect to nearby El Paso water and sewer system. In 2012 a plan was conceived to build 21 miles of pipeline to convey water from El Paso. This project would also include the construction of a new storage tank. After decades of planning, designing and applying for state and federal funds, the project was canceled for reasons internal to the community. In addition, a grant of approximately $500,000 from the Border Environment Cooperation Commission, previously reserved for Vinton, was eventually removed from the table and awarded elsewhere. Many residents within the community would love to have city water and are continuing to make positive strides towards obtaining a more secure water supply for future water supply needs.

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

- (E-40) High capacity water lines for improved distribution of water from EPWU

In addition to the above recommended water management strategies, the following water conservation management measures are suggested:

- Provide public with conservation information
- Promote Best Management Practices (BMPs) for residential and commercial water customers

The TWDB requires that water management strategies develop new water 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 here: https://www.twdb.texas.gov/financial/index.asp. The City of Vinton has the following project currently in the TWDB's Clean Water State Revolving Fund (CWSRF) application process.

- Design and construction of a new centralized wastewater collection system

E-40 High Capacity Water Lines for Improved Distribution of Water from EPWU

The City of Vinton has applied for financial assistance for the amount of $3,000,000 from the TWDB Drinking Water State Revolving Fund (DWSRF) program. The project is for the installation of new high capacity water lines, able to maintain a minimum pressure, to be tied into EPWU's water system. A service fee will be needed to allow EPWU to provide adequate water storage. This project will provide the City of Vinton with the community's first public water system.

Quantity, Reliability, and Cost – For this *Plan*, it is assumed that this strategy will yield an additional 400 acre-feet per year of water. Reliability of this source is high as it is part of the EPWU Integrated Strategy. The estimated total capital cost for this project is approximately $4,192,000. This amount is derived from taking the 2008 TWDB loan application cost and updating it to the 2013 dollar amount using the TWDB Costing Tool.

5A.13 WATER MANAGEMENT STRATEGIES FOR EL PASO COUNTY-OTHER

El Paso County-Other has a projected population of 38,422 in 2020; increasing to 54,927 by 2070 which includes individuals living outside of a named water user group. Much of this compilation of users known as County-Other relies on water serviced by EPWU. El Paso County Other has a projected water supply deficit of 368 acre-feet in 2020; increasing to 2,745 acre-feet by 2070. The following water management strategy is recommended to enhance the reliability of the future water supply availability for rural residents within El Paso County:

- (E-41) Public Conservation Education
- (E-42) Purchase water from El Paso Water Utilities (EPWU)

In addition to the above recommended water management strategy, the following water conservation management measures are suggested:

- Promote Best Management Practices (BMPs) for residential and commercial water customers

E-41 Public Conservation Education

County-Other entities are encouraged to emphasize conservation through public information programs. EPWU will likely provide this service to many of the citizens in this category. A total of one percent reduction in demand is anticipated, which would result in a water savings of 9 acre-feet by year 2030. The 2030 annual cost for implementing a public information conservation program is estimated at $1,818.

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 BMPs that might be encouraged is available in *TWDB Report 362, Water Conservation Best Management Practices Guide.*

E-42 Purchase Water from El Paso Water Utilities (EPWU)

County-Other entities have historically purchased a portion of its water supply from EPWU. This strategy provides for the purchase of additional water supplies from EPWU to meet their projected future supply needs. The purchased supply is reliant on EPWU maintaining its blended water supply and implementation of its Integrated Strategies (5A.5). This strategy assumes that El Paso County-Other entities will purchase 368 acre-feet per year of water from EPWU at a cost of approximately $679 per acre-foot. The total annual cost for the water purchase is approximately $250,000.

5A.14 WATER MANAGEMENT STRATEGIES FOR EL PASO COUNTY IRRIGATION (EPCWID #1)

Irrigation shortages in El Paso County are the direct result of insufficient water in the Rio Grande during drought-of-record periods to meet anticipated needs. Thus, the quantity of water needed to meet the full demands cannot be realistically achieved during drought conditions and farmers in these areas have generally approached this situation by supplementing supplies with Rio Grande Alluvium Aquifer groundwater, reducing irrigated acreage, 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 Best Management Practices (BMPs) for agricultural water users, 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 Texas Water Development Board (TWDB), through the Water Conservation Implementation Task Force has published a report title *Water Conservation Best Management Practices* Guide (TWDB Report 362), which in part contains numerous BMPs for agricultural water users.

During the previous planning period, the FWTWPG sponsored and the TWDB funded an interim project to evaluate the effectiveness of previously recommended irrigation BMP strategies. The evaluation was conducted by the Texas AgriLife Research Center in El Paso. The entire report can be viewed at http://www.twdb.texas.gov/publications/reports/contracted_reports/doc/0704830690_RegionE/TxAgriLifeResearchIrrigationEfficiency-FinalReport.pdf.

The overall conclusion is that very limited opportunities exist for significant additional water conservation in Far West Texas irrigated agriculture. Those practices that suggest economic efficient additional water conservation include lining or pipelining district canals and the very small potential for additional irrigation scheduling and tail water recovery systems. In nearly all cases, these practices have been adopted to a large extent if applicable, further emphasizing the very limited opportunities for additional conservation. If all of these strategies were implemented, the water conserved would satisfy less than 25 percent of the projected unmet agricultural water demand in 2070 during drought-of-record conditions.

Based on this evaluation, the FWTWPG recommends irrigation scheduling, tailwater reuse, and improvements to water district delivery systems strategies to attempt to meet the estimated irrigation needs in El Paso County. These strategies are intended for irrigation practices within the El Paso County Water Improvement District #1. The potential water savings under both drought and full supply conditions is shown in the table below.

Potential Water Savings for EPCWID #1

BMP Strategy	Drought	Full
Scheduling (subtotal)	1,740	5,070
Pivot Sprinkler	-	-
Surface Irrigation	-	-
Pipeline / Lining District Canals	25,000	50,000
Tailwater Reuse	1,723	6,274
Total	**28,463**	**61,344**

El Paso County has approximately 68,470 acre-feet of an irrigation shortage in 2020. The following water management strategies are recommended to enhance the reliability of the future water supply availability for the irrigation needs within El Paso County:

- (E-43) Irrigation scheduling
- (E-44) Tailwater reuse
- (E-45) Improvements to water district delivery systems

E-43 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.

Due to the recent drought, EPCWID #1 has made several changes to aid the agricultural sector. Farmland is currently being irrigated with effluent (sewer treated) water. In 2015, 10,000 acres were irrigated in this manner. Also, modifications have been made to the local irrigation schedule. Farmers will now wet their lands for planting starting in February (irrigating as much as possible), up until the beginning of the irrigation season starting June 1st. This strategy assumes that upon the release of the Rio Grande project water, the project water will be mixed with well water and the effluent water in order to produce more supply to be allocated to other users including the City of El Paso.

Quantity, Reliability, and Cost - Costs vary depending upon which scheduling method is used, number of fields scheduled, type of program and technical assistance. Based upon existing research conducted on surface water delivery through a series of canals, laterals, and on-farm distribution system, irrigation scheduling offers the potential to reduce water deliveries between 10 and 25 percent and more depending upon the capabilities of the individual district and producer. The project would have a benefit of 1,740 acre-feet per year. This strategy assumes an annual cost of approximately $102,595.

E-44 Tailwater Reuse

This strategy is applicable to any irrigated system in which significant water quantity runs off the end of the irrigated field. This strategy consists of ditches or pipelines to collect tailwater and deliver it to a storage reservoir or small field pump. The water is then pumped to the upper end of the field and applied with the irrigation water. Water savings from the installation of tailwater reuse systems are highly dependent upon the local water supply (groundwater or surface water) and the current on-farm water management practices of the grower. Water savings will typically vary between 5 and 25 percent of the water applied to the head (upper) end of the field. This may range from a few to several inches (0.5 to 1.5 acre-foot per acre per year).

Quantity, Reliability, and Cost – Reservoirs or pumps costs range between $35 and $70 per acre per year for pump systems and between $60 and $120 per acre per year for reservoir systems. This project will deliver approximately 1,723 acre-feet of water per year and has an estimated annual cost of $973,368.

E-45 Improvements to Water District Delivery Systems

EPCWID #1 continues to implement meaningful irrigation conservation measures. The District provides irrigation water for 69,010 acres, includes 350 miles of canals and 269 miles of drains, and supplies raw water to the City of El Paso. Improvements to the water district delivery system include but are not limited to: lining of District irrigation canals, replacement of District canals and lateral canals with pipelines.

Lining of District irrigation canals involves the installation of a fixed lining impervious material in an existing or newly constructed canal. Concrete lining of canals and replacement of headgates has been a critical component of irrigation conservation for the District. EPCWID #1 has lined 15 miles of canals within the last seven years, and strives to continue lining approximately 5 miles each upcoming year. This allows for water to be delivered more efficiently to the farms. In addition, in 2015 a joint project between EPCWID #1 and EPWU for $120,000 was implemented to repair and upgrade the canal infrastructure at the headgates.

In 2002, EPCWID #1 received state funding from the TWDB to perform a water and energy conservation feasibility study on lining three canal segments to reduce seepage, construction of check structures and storage, and equalization structures to increase the efficiency and flexibility of water delivery. Funds were available through oil overcharge fees collected by the State Energy Conservation Office and deposited in the Water Bank Account. Water savings involve reduced seepage from the installation of a lining material. Concrete liners are estimated to salvage 80 percent of the original seepage. Costs vary by lining method.

This strategy assumes that replacement of District canals and lateral canals with pipelines involves replacing open canals with buried pipeline that is generally 72 inches in diameter or less. PVC Plastic Irrigation Pipe (PIP) and Reinforced Concrete Pipe (RCP) are the two most commonly used pipelines. Two primary limitations involve cost and water capacity. Water savings stem from reduced seepage. Costs vary and depend on pipe diameter, transportation of pipes, trenching, and other site-specific considerations. Federal funds, state funds and local funds have contributed to the success of this strategy. With the purchase of the proper equipment, the goal is to eventually control the headgates of the system through both the dispatch office and the telemetry system.

Quantity, Reliability, and Cost – The estimated total capital cost for this project is approximately $157,777,783 and will deliver approximately 25,000 acre-feet per year.

5A.15 WATER MANAGEMENT STRATEGIES FOR EL PASO COUNTY MANUFACTURING

El Paso County Manufacturing entities have historically purchased a portion of their water supply from EPWU. This strategy provides for the purchase of additional water supplies from EPWU to meet their projected future supply needs. Manufacturing shortages in El Paso County is projected at 8,841 acre-feet per year in 2020; increasing to 15,050 acre-feet per year by 2070. The following water management strategy is recommended to enhance the Manufacturing sector's future water supply availability:

- (E-46) Purchase water from El Paso Water Utilities

E-46 Purchase Water from El Paso Water Utilities (EPWU)

This strategy assumes that El Paso County Manufacturing entities would purchase an additional 8,841 acre-feet per year of water from EPWU at a cost of approximately $1,168 per acre-foot. The total annual cost for the water purchase is approximately $10,326,000. The purchased supply is reliant on EPWU maintaining its blended water supply and implementation of its Integrated Strategies (5A.5).

5A.16 WATER MANAGEMENT STRATEGIES FOR EL PASO COUNTY MINING

El Paso County Mining entities purchase a portion of their water supply from EPWU; however, much of the water needs for mining operations are self-supplied from private water wells. Projected Mining water supply shortages in El Paso County do not appear until the 2050 decade with a 242 acre-feet per year deficit; increasing to 1,833 acre-feet per year by 2070. The following water management strategy is recommended to enhance the Mining industry's future water supply availability:

- (E-47) Additional groundwater wells in the Hueco-Mesilla Bolson Aquifer

E-47 Additional Groundwater Wells in the Hueco-Mesilla Bolson Aquifer

The Hueco-Mesilla Bolson Aquifer has been identified as a potential source of water to meet the mining shortages within El Paso County. This Aquifer, a major source of groundwater for cities in El Paso County, extends southeastward from the Franklin Mountains in El Paso County to the southern end of the Quitman Mountains in Hudspeth County. The Aquifer also extends southward into the Mexican State of Chihuahua, where it is bounded by a series of mountain ranges that trend toward the southeast from Ciudad Juarez, to near the southernmost point of the Quitman Mountains in Texas.

Water from this source is typically good. Fresh to slightly saline water exist in the upper portions of the bolson. Brackish water exists at greater depths and is recommended for mining purposes. This strategy assumes that two new wells will need to be drilled to provide approximately 1,840 acre-feet per year. These wells will produce water from approximately 585 feet below the surface.

Quantity, Reliability, and Cost – The quantity and reliability of water from this source is expected to be approximately 630 gpm. Historical municipal and industrial use indicates that the Hueco-Mesilla Bolson Aquifer may be a viable source. For this *Plan*, two new wells are assumed to supply an additional 1,840 acre-feet per year. The reliability of this supply is considered to be medium to high, based on competing demands and water quality issues. Total cost of this project will be approximately $969,000.

5A.17 WATER MANAGEMENT STRATEGIES FOR EL PASO COUNTY STEAM ELECTRIC POWER

Steam Electric Power water supply shortages in El Paso County is projected at 3,651 acre-feet per year in 2020; increasing to 12,651 acre-feet per year by 2070. Water supply needs are met partly by EPWU's blended source along with obtaining self-supplied groundwater from the Hueco-Mesilla Bolson Aquifer. The following water management strategy is recommended to enhance the reliability of the future water supply availability for industrial use in El Paso County.

- (E-48) Purchase water from El Paso Water Utilities

E-48 Purchase Water from El Paso Water Utilities (EPWU)

This strategy assumes that Steam Electric Power would purchase 3,651 acre-feet of water from EPWU in 2020 at a cost of $475 per acre-foot. The total annual cost for the water purchase is approximately $1,734,000. The purchased supply is reliant on EPWU maintaining its blended water supply and implementation of its Integrated Strategies (5A.5).

5A.18 WATER MANAGEMENT STRATEGIES FOR HUDSPETH COUNTY-OTHER (DELL CITY)

Hudspeth County-Other has a projected total population of 3,293 in 2020; increasing to 3,851 by 2070, which includes individuals living outside of a named water user group. This includes the Community of Dell City. Dell City relies on the Bone Spring-Victorio Peak Aquifer for its municipal supply. Although the supply-demand analysis does not project a future water supply deficit for Hudspeth County-Other or Dell City, the following water management strategies are recommended to enhance the reliability of Dell City's future water supply availability:

- (E-49) Water loss audit and main-line repair for Dell City
- (E-50) Brackish groundwater desalination facility

In addition to the above recommended water management strategy, the following water conservation management measures are suggested:

- Promote Best Management Practices (BMPs) for residential and commercial water customers

E-49 Water Loss Audit and Main-line Repair for Dell City

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. A more detailed description of this best management practice is available in *TWDB Report 362, Water Conservation Best Management Practices Guide*, and in the *TWDB Water Loss Manual*. The reliability of this water savings is contingent on the aggressive implementation of this BMP and the public's willingness to do their part. The community should also look towards conservation measures through public information, progressive water rate increases and by implementing a water waste ordinance.

According to the 2010 TWDB Public Water System Water Loss Survey, Dell City had a total water loss of 2,697,469 gallons (8.28 acre-feet) in 2010 (17%) due to leaking distribution lines and/or faulty meters. This amount of water loss is the sum of reported breaks and leaks and unreported loss. Taking the proper measures to identify and repair old infrastructure and inaccurate water meters, the City can reduce the unaccounted for water and get a more accurate look at water consumption.

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. The strategy assumes 8.5 miles of distribution line will be replaced, at a total estimated project capital cost of $1,614,000; and will generate a potential savings of 1.41 acre-feet of water per year. Temporary land disturbance will occur as distribution lines are excavated and repaired. However, no long-term negative environmental, agricultural, or natural resources impacts are anticipated.

E-50 Brackish Groundwater Desalination Facility

Aided by financial assistance from the TWDB, Dell City has plans to replace the City's water treatment facility with a reverse osmosis system. The existing ionic filtration system is outdated and replacement parts are difficult to obtain. In addition, the City's groundwater source exceeds water quality standards for total dissolved solids and fluoride. This strategy incorporates Dell City's funding application from the TWDB Drinking Water State Revolving Fund (DWSRF) for an amount of $244,450.

This strategy assumes that 111 acre-feet per year of groundwater from the Bone Spring-Victorio Peak Aquifer will be treated by the reverse osmosis treatment plant. It is assumed that all other necessary infrastructure (e.g., piping, concentrate disposal) is currently in place for the existing facility and will not need to be updated.

Quantity, Reliability, and Cost – For this *Plan*, this strategy assumes an additional supply of 111 acre-feet of water per year. The reliability of this strategy is high due to the sufficient amounts of brackish groundwater. It is estimated that the total capital cost for this project is $1,299,000.

5A.19 WATER MANAGEMENT STRATEGIES FOR HUDSPETH COUNTY-OTHER (FORT HANCOCK WCID)

Hudspeth County Other has a projected total population of 3,293 in 2020; increasing to 3,851 by 2070, which includes individuals living outside of a named water user group. This includes Fort Hancock WCID. The Fort Hancock WCID relies on the Hueco Bolson Aquifer for its municipal supplies. Although the supply-demand analysis does not project a future water supply deficit for the District, the following water management strategies are recommended to enhance the reliability of the District's future water supply availability:

- (E-51) Water loss audit and main-line repair for Fort Hancock WCID
- (E-52) Additional well and RO treatment facility

In addition to the above recommended water management strategy, the following water conservation management measures are suggested:

- Promote Best Management Practices (BMPs) for residential and commercial water customers

E-51 Water Loss Audit and Main-line Repair for Fort Hancock WCID

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. A more detailed description of this best management practice is available in *TWDB Report 362, Water Conservation Best Management Practices Guide*, and in the *TWDB Water Loss Manual*. The reliability of this water savings is contingent on the aggressive implementation of this BMP and the public's willingness to do their part. The community should also look towards conservation measures through public information, progressive water rate increases and by implementing a water waste ordinance.

According to the 2010 TWDB Public Water System Water Loss Survey, Fort Hancock WCID had a total water loss of 3,841,446 gallons (11.8 acre-feet) in 2010 (22%) due to leaking distribution lines and/or faulty meters. This amount of water loss is the sum of reported breaks and leaks and unreported loss. Taking the proper measures to identify and repair old infrastructure and inaccurate water meters, the District can reduce the unaccounted for water and get a more accurate look at water consumption.

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. The strategy assumes 1.5 miles of distribution line will be replaced, at a total estimated project capital cost of $292,000; and will generate a potential savings of 2.6 acre-feet of water per year.

E-52 Additional Well and RO Treatment Facility

Aided by financial assistance from the TWDB, Fort Hancock WCID completed a water well and RO treatment facility in 2010. This strategy includes the following: drill a second water well into the Hueco Bolson Aquifer and construct 6,900 feet of collector pipeline, a 30,000 gallon raw water charge tank and pump station, a reverse osmosis treatment system, a 30,000 gallon ground storage tank, a booster pumping station, 8,500 feet of 8-inch diameter transmission line to deliver finished water to the existing elevated storage tank, two evaporation ponds for reject water, building for the RO unit and chemical storage, an all-weather access road, electrical service, and a SCADA system. The District had an Agreed Temporary Injunction by the Office of the Attorney General and TCEQ for source and quality issues. The District also used $904,000 in assistance from the USDA Rural Utilities Division.

Quantity, Reliability, and Cost – For this *Plan*, this strategy assumes an additional supply of 565 acre-feet per year. The reliability of this strategy is medium to high based on other competing demands for this same source. The total estimated capital cost for this project is approximately $6,109,000. This amount is derived from taking the 2008 TWDB loan application cost and updating it to the 2013 dollar amount using the TWDB Costing Tool.

5A.20 WATER MANAGEMENT STRATEGIES FOR HUDSPETH COUNTY-OTHER (CITY OF SIERRA BLANCA-HUDSPETH COUNTY WCID #1)

Hudspeth County-Other has a projected total population of 3,293 in 2020; increasing to 3,851 by 2070, which includes individuals living outside of a named water user group. This includes the City of Sierra Blanca (Hudspeth County WCID #1). The City of Sierra Blanca (Hudspeth County WCID #1) derives its water supply from groundwater wells in the West Texas Bolson – Salt Basin (Wildhorse Flat) Aquifer near Van Horn in Culberson County. Although the supply-demand analysis does not project a future water supply deficit for the District, the following water management strategy is recommended to enhance the reliability of the District's future water supply availability:

- (E-53) Additional transmission line to supply connections outside of the District

In addition to the above recommended water management strategy, the following water conservation management measures are suggested:

- Provide public with conservation information
- Promote Best Management Practices (BMPs) for residential and commercial water customers

E-53 Additional Transmission Line to Supply Connections Outside of the District

The Hudspeth county WCID #1 plans to extend its service area to beyond its current boundary, thus providing additional water to citizens in the County-Other category. This strategy assumes three miles of six-inch diameter piping will be installed for a total project capital cost of approximately $1,429,000.

Quantity, Reliability, and Cost – For this *Plan*, this strategy assumes an additional supply of 351 acre-feet per year of water. The reliability of this strategy is high since the project is only requiring supplementary transmission line to existing storage facilities. The estimated total project cost is $1,429,000.

5A.21 WATER MANAGEMENT STRATEGIES FOR HUDSPETH COUNTY IRRIGATION (HCCRD #1)

Irrigation shortages in Hudspeth County are the direct result of insufficient water in the Rio Grande during drought-of-record periods to meet anticipated needs. The quantity of water needed to meet the full demands cannot be realistically achieved and farmers in these areas have generally approached this situation by reducing irrigated acreage, 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 Best Management Practices (BMPs) for agricultural water users, 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 Texas Water Development Board (TWDB), through the Water Conservation Implementation Task Force has published a report title *Water Conservation Best Management Practices Guide (TWDB Report 362)*, which in part contains numerous BMPs for agricultural water users.

During the previous planning period, the FWTWPG sponsored and the TWDB funded an interim project to evaluate the effectiveness of previously recommended irrigation best management practice strategies. The evaluation was conducted by the Texas AgriLife Research Center in El Paso. The entire report can be viewed at http://www.twdb.texas.gov/publications/reports/contracted_reports/doc/0704830690_RegionE/TxAgriLifeResearchIrrigationEfficiency-FinalReport.pdf.

The overall conclusion is that very limited opportunities exist for significant additional water conservation in Far West Texas irrigated agriculture. Those practices that suggest economic efficient additional water conservation include lining or pipelining district canals and the very small potential for additional irrigation scheduling and tail water recovery systems. In nearly all cases, these practices have been adopted to a large extent if applicable, further emphasizing the very limited opportunities for additional conservation. If all of these strategies were implemented, the water conserved would satisfy less than 25 percent of the projected unmet agricultural water demand in 2070 during drought-of-record conditions.

Based on this evaluation, the FWTWPG recommends irrigation scheduling, tailwater reuse, and improvements to water district delivery systems strategies to attempt to meet the estimated irrigation needs in Hudspeth County. The strategies are intended for irrigation practices within the Hudspeth County Conservation and Reclamation District #1. The potential water savings under both drought and full supply conditions is shown in the table below.

Potential Water Savings for HCCRD #1

BMP Strategy	Drought	Full
Scheduling (subtotal)	0	1,275
Pivot Sprinkler	-	-
Surface Irrigation	-	-
Pipeline / Lining District Canals	-	-
Tailwater Reuse	0	1,275
Total	**0**	**2,550**

Hudspeth County has approximately 94,847 acre-feet of projected irrigation water supply shortage in 2020, which is primarily due to low or no flows in the Rio Grande during drought-of-record conditions. As a result, there are identified shortages that may not be able to be met by supplies within the county. The following water management strategy is recommended to enhance the Irrigation District's reliability of the future water supply availability:

- (E-54) Additional groundwater wells in the Rio Grande Alluvium Aquifer

In addition to the above recommended water management strategy, the following water conservation management measures are suggested:

- Promote Best Management Practices (BMPs) for irrigation

E-54 Additional Groundwater Wells in the Rio Grande Alluvium Aquifer

The Rio Grande Alluvium Aquifer has been identified as a potential source of water to partially meet the irrigation needs (HCCRD #1) in Hudspeth County. Water from this source is generally poor. Groundwater contained within the shallow alluvial sediments generally has high concentrations of dissolved solids (typically greater than 2,000 mg/l), and would require desalination for municipal purposes. However, it is a temporary source of irrigation water whenever flow in the Rio Grande is insufficient to support agricultural operations. This strategy assumes that two new wells will be drilled to provide 230 acre-feet per year. These wells will produce water from approximately 100 feet below the surface.

Quantity, Reliability, and Cost - The quantity and reliability of water from this source is expected to be approximately100 gpm. Historical municipal, industrial and agricultural use indicates that the Rio Grande Alluvium Aquifer may be a viable source. Groundwater contained within the shallow alluvial sediments generally has high concentrations of dissolved solids, requiring advanced treatment for municipal use. However, this source is used for irrigation whenever flow in the Rio Grande is insufficient to support agricultural operations. These irrigation wells are capable of annually producing approximately 15,000 acre-feet in Hudspeth County.

For this *Plan*, two new wells are assumed to supply an additional 230 acre-feet per year. The reliability of this supply is considered to be medium to high, based on competing demands and water quality issues. Total cost of this project will be approximately $173,000.

5A.22 WATER MANAGEMENT STRATEGIES FOR HUDSPETH COUNTY IRRIGATION (HCUWCD #1)

Irrigation shortages in Hudspeth County are the direct result of insufficient water in the Rio Grande during drought-of-record periods to meet anticipated needs. The quantity of water needed to meet the full demands cannot be realistically achieved and farmers in these areas have generally approached this situation by reducing irrigated acreage, 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 Best Management Practices (BMPs) for agricultural water users, 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 Texas Water Development Board (TWDB), through the Water Conservation Implementation Task Force has published a report title *Water Conservation Best Management Practices Guide (TWDB Report 362)*, which in part contains numerous BMPs for agricultural water users.

During the previous planning period, the FWTWPG sponsored and the TWDB funded an interim project to evaluate the effectiveness of previously recommended irrigation best management practice strategies. The evaluation was conducted by the Texas AgriLife Research Center in El Paso. The entire report can be viewed at http://www.twdb.texas.gov/publications/reports/contracted_reports/doc/0704830690_RegionE/TxAgriLifeResearchIrrigationEfficiency-FinalReport.pdf.

The overall conclusion is that very limited opportunities exist for significant additional water conservation in Far West Texas irrigated agriculture. Those practices that suggest economic efficient additional water conservation include lining or pipelining district canals and the very small potential for additional irrigation scheduling and tail water recovery systems. In nearly all cases, these practices have been adopted to a large extent if applicable, further emphasizing the very limited opportunities for additional conservation. If all of these strategies were implemented, the water conserved would satisfy less than 25 percent of the projected unmet agricultural water demand in 2070 during drought-of-record conditions.

Based on this evaluation, the FWTWPG recommends irrigation scheduling, tailwater reuse, and improvements to water district delivery systems strategies to attempt to meet the estimated irrigation needs in Hudspeth County. The strategies are intended for irrigation practices within the Hudspeth County Underground Water Conservation District #1 (HCUWCD #1). The potential water savings under both drought and full supply conditions is shown in the table below.

Potential Water Savings for HCUWCD#1

BMP Strategy	Drought	Full
Scheduling (subtotal)	3,535	11,179
Pivot Sprinkler	2,357	7,453
Surface Irrigation	1,178	3,726
Pipeline / Lining District Canals	N/A	N/A
Tailwater Reuse	589	1,863
Total	**4,124**	**13,032**

Hudspeth County has approximately 94,847 acre-feet of projected total irrigation shortage in 2020; decreasing to 77,060 acre-feet per year by 2070. However, very little or none of this shortage is associated with the irrigation activity in the Dell Valley area that is managed by the HCUWCD #1. The following water management strategies are recommended to enhance the District's reliability of the future water supply availability:

- (E-55) Irrigation Scheduling
- (E-56) Tailwater Reuse

In addition to the above recommended water management strategy, the following water conservation management measures are suggested:

- Promote Best Management Practices (BMPs) for irrigation
- Volumetric measurement of irrigation water
- Crop residue management and conservation tillage
- Land leveling
- Lining of on-farm irrigation ditches
- Low pressure center pivot sprinkler systems
- Use of Gated/Flexible pipe for field water distribution
- Regulating of the aquifer

E-55 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 between 7 percent and 15 percent of water pumped with costs ranging between $10 and $86 per acre-foot. Additional savings are possible from reduced pumping costs.

Quantity, Reliability, and Cost - Costs vary depending upon scheduling method used, number of fields scheduled, type of program and technical assistance. Based upon existing research conducted on surface water delivery through a series of canals, laterals, and on-farm distribution system, irrigation scheduling offers the potential to reduce water deliveries between 10 and 25 percent and more depending upon the capabilities of the individual district and producer. It is assumed that the total annual cost would be approximately $289,157. This strategy may conserve approximately 3,535 acre-feet of water per year.

E-56 Tailwater Reuse

This strategy is applicable to any irrigated system in which a significant water quantity runs off the end of the irrigated field. The strategy consists of ditches or pipelines to collect tailwater and deliver it to a storage reservoir or small field pump. The water is then pumped to the upper end of the field and applied with the irrigation water. Water savings from the installation of tailwater reuse systems are highly dependent upon the local water supply (groundwater or surface water) and the current on-farm water management practices of the grower. Water savings will typically vary between 5 and 25 percent of the water applied to the head (upper) end of the field. This may range from a few to several inches (0.5 to 1.5 acre-foot per acre per year).

This strategy assumes a savings between 10 to 15 percent, with a cost of $329 per acre-foot. It is assumed that the total annual cost is approximately $207,394.

Quantity, Reliability, and Cost - It is assumed that the total annual cost is approximately $207,394 and that this strategy may conserve approximately 589 acre-feet of water per year.

5A.23 WATER MANAGEMENT STRATEGIES FOR HUDSPETH COUNTY MINING

Mining water supply shortages in Hudspeth County are projected at 21 acre-feet per year in 2070. Mining water supply needs within the county obtain supplies from both surface and groundwater sources. Surface water such as local supply is commonly used, but limited during drought conditions. Groundwater from the Rio Grande Alluvium Aquifer and West Texas Bolsons Aquifer are more reliable sources. The following water management strategy is recommended to enhance the reliability of the future water supply availability for the mining water-supply needs within Hudspeth County:

- (E-57) Additional groundwater well in the West Texas Bolsons (Eagle Flat) Aquifer

E-57 Additional Groundwater Well in the West Texas Bolsons (Eagle Flat) Aquifer

The West Texas Bolsons Aquifer has been identified as a potential source of water to meet the mining shortages within Hudspeth County. The Eagle Flat Bolson is situated between the Eagle Mountains along the south-southwest, the Diablo Plateau along the north, and the Carrizo and Van Horn Mountains along the east. Groundwater underlying the Eagle Flat area is not a source of supply for municipalities in Hudspeth County due to water quality and quantity limitations. However, the Eagle Flat is a sufficient source for mining purposes. This strategy assumes that one new well will be drilled to 375 feet below the surface.

Quantity, Reliability, and Cost – The quantity and reliability of water from this source is expected to be approximately 240 gpm. Historical industrial and agricultural use indicates that the West Texas Bolsons Aquifer may be a viable source. For this *Plan*, the one new well is assumed to supply an additional 30 acre-feet per year. The reliability of this supply is considered to be medium to high, based on competing demands and water quality issues. Total cost of this project will be approximately $449,000.

5A.24 WATER MANAGEMENT STRATEGIES FOR FORT DAVIS WSC

Fort Davis Water Supply Corporation (FDWSC) provides water to the Community of Fort Davis and the surrounding area from three wells completed in the Davis Mountains Igneous Aquifer, and continues to consider the feasibility of future water well development in surrounding areas. The FTWSC has a projected water demand of 297 acre-feet per year in 2020; increasing to 285 acre-feet per year by 2070. Although the supply-demand analysis does not project a future water supply deficit for the FDWSC, the following water management strategies are recommended to enhance the reliability of the future water supply availability:

- (E-58) Additional groundwater well in the Igneous Aquifer
- (E-59) Additional transmission line to connect Fort Davis WSC to Fort Davis Estates

In addition to the above recommended water management strategies, the following water conservation management measures are suggested:

- Provide public with conservation information
- Promote Best Management Practices (BMPs) for residential and commercial water customers

E-58 Additional Groundwater Well in the Igneous Aquifer

The FDWSC produces groundwater from the Igneous Aquifer, which is not a single homogeneous aquifer but rather a system of complex water-bearing formations that are in varying degrees of hydrologic communication. This strategy assumes that one new well will be drilled and equipped to produce approximately 255 gpm. This well would be located on the opposite end from the existing storage facility, and produce water from approximately 300 feet below the surface. In addition, 500 feet of eight-inch diameter connection pipeline will be necessary to connect to the storage facility. Minimal treatment will be required, such as chlorination disinfection for municipal use.

Quantity, Reliability, and Cost – This strategy assumes one new well generating approximately 274 acre-feet per year. The combined supplies from strategies using water from the Igneous Aquifer do not exceed the MAG value, indicating there are sufficient supplies for these strategies. The total estimated project cost is approximately $507,000. Water quality of the aquifer is relatively good and generally meets safe drinking water standards. Minimal treatment will be required for municipal purposes. The reliability of this supply is considered to be medium to high, based on competing demands.

E-59 Additional Transmission Line to Connect Fort Davis WSC to Fort Davis Estates

FDWSC provides water to the Community of Fort Davis and the surrounding area which includes Fort Davis Estates. FDWSC has plans to construct an additional transmission line in order to connect FDWSC to the Fort Davis Estates subdivision, which has its own well. This strategy assumes the connection of 20 houses, with a 2 mile, 6” diameter transmission pipeline. Conveyance of water would flow both directions depending on peak demand. This pipeline would only be used for emergency purposes to meet the peak demand during summer months. Funding is expected to be provided solely by Fort Davis WSC.

Quantity, Reliability, and Cost – This strategy would supply 114 acre-feet per year and the total estimated capitol cost for this project is $1,068,000.

5A.25 WATER MANAGEMENT STRATEGIES FOR JEFF DAVIS COUNTY-OTHER (TOWN OF VALENTINE)

The Town of Valentine, a small community in western Jeff Davis County, currently derives its entire water supply from one groundwater well completed in the Ryan Flat portion of the Salt Basin Aquifer, a subdivision of the West Texas Bolson Aquifers. A second well is needed as a supplemental and backup supply for the community. Although the supply-demand analysis does not project a future water-supply deficit for the Town of Valentine, the following water management strategy is recommended to enhance the reliability and security of the community's future water supply availability:

- (E-60) Additional groundwater well in the Salt Basin Aquifer

E-60 Additional Groundwater Well in the Salt Basin Aquifer

This strategy assumes that one new municipal well is needed to provide an additional water supply for the Town of Valentine. This new groundwater, well likewise completed in the Salt Basin Aquifer (Ryan Flat) would be located near the existing well and drilled to a depth of approximately 870 feet below the surface. In addition, 500 feet of six-inch diameter connection pipeline will be necessary. Minimal treatment will be required, such as chlorination disinfection for municipal use.

Quantity, Reliability, and Cost – The total estimated project capital cost is approximately $402,808. The well is expected to reliably yield approximately 40 gpm and produce 65 acre-feet per year. The combined supplies from strategies using water from the Salt Basin Aquifer do not exceed the MAG value, indicating there are sufficient supplies for these strategies. Water quality of the Aquifer is relatively good and generally meets safe drinking water standards. Minimal advanced treatment will be required for municipal purposes.

5A.26 WATER MANAGEMENT STRATEGIES FOR THE CITY OF MARFA

The City of Marfa and many other residents of Presidio County rely on the Igneous Aquifer for municipal, domestic, livestock and irrigation water-supply needs. The City's population is projected to increase from 2,203 in 2020 to 3,134 by 2070. The City of Marfa depends on three city-owned wells for all of its municipal water needs. Two of the three wells are capable of producing a much as 1,100 gpm, and the third well yields an additional 450 gpm. Other than fluoride, which has been reported at concentrations ranging from 2.5 to 3 mg/l, all other dissolved solids are below their respective drinking water standards, and TDS are typically less than 400 mg/l. An additional well and a treatment facility to mitigate the fluoride issue are currently in the planning and design phase.

Although the supply-demand analysis does not project a future water-supply deficit for the City of Marfa, the following water management strategy is recommended to enhance the reliability of the City's future water supply availability:

- (E-61) Additional groundwater well in the Igneous Aquifer

In addition to the above recommended water management strategies, the following water conservation management measures are suggested:

- Provide public with conservation information
- Promote Best Management Practices (BMPs) for residential and commercial water customers

The TWDB requires that water management strategies develop new (additional) water to be applicable for SWIFT funding. Projects that involve replacing and/or repairing old infrastructure 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 here: http://www.twdb.gov/financial/index.asp. Water management strategies considered but do not meet SWIFT qualifications:

- Construct effluent storage pond for irrigation use

E-61 Additional Groundwater Well in the Igneous Aquifer

The City of Marfa relies on the Igneous Aquifer as its sole source of municipal water supply. This Aquifer is not a single homogeneous aquifer but rather a system of complex water-bearing formations that are in varying degrees of hydrologic communication. This strategy assumes that one new well will be drilled within the city boundary to approximately 860 feet in depth and equipped to generate approximately 730 gpm.

Quantity, Reliability, and Cost – The quantity and reliability of water from this source is expected to be approximately 785 acre-feet of water per year. The combined supplies from strategies using water from the Igneous Aquifer do not exceed the MAG value, indicating there are sufficient supplies for these strategies. Water quality of the aquifer is relatively good and generally meets safe drinking water standards. Minimal advanced treatment will be required for municipal purposes. The reliability of this supply is considered to be medium to high, based on competing demands. The total estimated project cost is approximately $1,143,000.

5A.27 WATER MANAGEMENT STRATEGIES FOR THE CITY OF PRESIDIO

The City of Presidio is located on the Rio Grande adjacent from Ojinaga, Chihuahua on the U.S.-Mexico Border. The City and many other border residents of Presidio County rely on the West Texas Bolsons – Presidio-Redford Bolson Aquifer for municipal, domestic, livestock and irrigation water supply needs. The City's population is projected to increase from 4,867 in 2020 to 6,722 by 2070. Although the supply-demand analysis does not project a future water supply deficit for the City of Presidio, the following water management strategy is recommended to enhance the reliability of the City's future water supply availability:

- (E-62) Water loss audit and main-line repair
- (E-63) Additional groundwater well in the West Texas Bolsons Aquifer

In addition to the above recommended water management strategies, the following water conservation management measures are suggested:

- Provide public with conservation information
- Promote Best Management Practices (BMPs) for residential and commercial water customers

The TWDB requires that water management strategies develop new (additional) water to be applicable for SWIFT funding. Projects that involve replacing and/or repairing old infrastructure 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 here: http://www.twdb.gov/financial/index.asp. Water management strategies considered but do not meet SWIFT qualifications:

- Rehabilitate existing water tanks
- Complete water meter conversion

E-62 Water Loss Audit and Main-line Repair

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. A more detailed description of this best management practice is available in *TWDB Report 362, Water Conservation Best Management Practices Guide*, and in the *TWDB Water Loss Manual*. The reliability of this water savings is contingent on the aggressive implementation of this BMP and the public's willingness to do their part. The community should also look towards conservation measures through public information, progressive water rate increases and by implementing a water waste ordinance.

According to the 2010 TWDB Public Water System Water Loss Survey, the City of Presidio had a total water loss of 22,526,722 gallons (69.13 acre-feet) in 2010 (13%) due to leaking distribution lines and/or faulty meters. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. Taking the proper measures to identify and repair old infrastructure and inaccurate water meters, the water supply system can reduce the unaccounted for water and get a more accurate look at water consumption.

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. The strategy assumes 11 miles of 6-inch diameter pipe will be replaced, at a total estimated project capital cost of $2,172,000; and will generate a potential savings of 9 acre-feet of water per year.

E-63 Additional Groundwater Well in the West Texas Bolsons Aquifer

The City of Presidio has plans to develop new water supplies to meet growing water demands within the community. Currently, the Border Environment Cooperation Commission is working with the City of Presidio to develop several improvements to the City's existing water infrastructure. One such project is to extend water services along Highway 67 as far as the airport to provide services to Las Pampas Colonia. Presidio Lely International Airport lies approximately 5 miles north of town. Historically this location has not had a reliable public water supply. This is due to minimal to no growth occurring north of town. The new water line will benefit approximately 12 existing residences and an equal number of businesses. This strategy assumes that one new well will be drilled into the West Texas Bolsons Aquifer (Presidio-Redford Bolson) to a depth of 90 feet to generate approximately 150 gpm. The estimated total capital cost of $1,861,000 includes 5 miles of 8-inch diameter transmission pipeline, one pump station, one 50,000 gallon storage tank and minimal treatment such as chlorine disinfection.

Quantity, Reliability, and Cost – The total estimated project cost is approximately $1,861,000. The quantity and reliability of water from this source is expected to be approximately 120 acre-feet of water per year. The combined supplies from strategies using water from the West Texas Bolsons Aquifer do not exceed the MAG value, indicating there are sufficient supplies for these strategies. Water quality of the aquifer is relatively good and generally meets safe drinking water standards. Minimal advanced treatment will be required for municipal purposes. The reliability of this supply is considered to be low to medium based on finding a good location for a productive well.

5A.28 WATER MANAGEMENT STRATEGIES FOR TERRELL COUNTY MINING

Mining interests in Terrell County obtains their water from local surface water supplies and from the Edwards-Trinity (Plateau) Aquifer. Local surface water sources are commonly used, but limited during drought conditions. The Aquifer source is more reliable and is thus identified as a potential supply to meet the projected mining water supply deficits which are projected at 449 acre-feet per year in 2020; increasing to 552 acre-feet per year by 2030; and then diminishing to 161 acre-feet per year by 2070. The following water management strategy exceeds the current MAG groundwater availability and therefore cannot be recommended. However, this strategy is included as an “alternate” strategy designed to be recommended upon a change in DFC and MAG availabilities in future planning cycles, or by a rules modification by the Terrell County Groundwater Conservation District.

- (E-64) Additional wells in the Edwards-Trinity (Plateau) Aquifer

E-64 Additional Wells in the Edwards-Trinity (Plateau) Aquifer

This strategy assumes that six new wells will be drilled to approximately 545 feet below the surface. This quantity of supply is not shown as currently available under the MAG limitations for the Edwards-Trinity (Plateau) Aquifer in Terrell County; therefore this strategy is included in the *Plan* as an “alternate” strategy. Should the MAG change in future planning cycles, this strategy will become a recommended strategy.

Quantity, Reliability, and Cost – Historical use indicates that the Edwards-Trinity (Plateau) Aquifer may be a viable source. For this *Plan*, the six new wells are assumed to supply an additional 560 acre-feet per year. The reliability of this supply is considered to be medium to high, based on competing demands and water quality issues. Total cost of this project will be approximately $738,000.

APPENDIX 5B
STRATEGY EVALUATION QUANTIFICATION MATRIX

This page intentionally left blank.

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 Far West Texas Water Planning Group 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
- Impact on Ecologically Unique Stream Segments

Table 5-4:

- Environmental Impact
  - Threatened and endangered species
  - Environmental water needs
  - Wildlife habitat
  - Cultural resources
  - Environmental water quality
  - Bays and estuaries

<u>Quantity, Quality and Reliability</u>

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

Quantity 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.

Quality adequacy is measured in terms of meeting TCEQ Safe Drinking Water Standards. However, not all strategies are intended for use requiring SDWSs.

Reliability 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 sustainable. Strategies that use water from a source that is available during normal meteorological conditions, but may not be 100% available during drought are rated as interruptible. Strategies in which 100% of the supply cannot be maintained even during normal meteorological conditions are rated as un-sustainable.

Impact on Water, Agricultural and Natural Resources, and Ecologically Unique Stream Segments

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	Ecologically Unique Streams
1	Positive	Positive	Positive	Positive
2	None	None	None	None
3	Low	Low	Low	Low
4	Medium	Medium	Medium	Medium
5	High	High	High	High

Water Resources 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% reduction in average surface flows

4 Medium – 10 to 50 feet of aquifer drawdown; 10 to 30% reduction in average surface flows

5 High - > 50 feet of aquifer drawdown; > 30% 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 Far West Texas.

1 Positive – provides water to agricultural users

2 None – does not impact agricultural supplies

3 Low – reduces agricultural activity by less than 10%

4 Medium – reduces agricultural activity by more than 10%

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 1.2.9 in Chapter 1 for a detailed discussion on the Natural Resources of Far West Texas.

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%

4 Medium – reduces natural resources water supply by more than 10%

5 High – reduces natural resources water supply by more than 50%

Ecologically Unique Stream Segments impacts are those that impact the natural habitat of portions of streams that have been identified by the Far West Texas Water Planning Group as "ecologically unique stream segments". See Chapter 8 of both the 2011 and 2016 Far West Texas Water Plan for a location and description of designated stream segments.

1 Positive – provides water to designated stream segments

2 None – does not impact designated stream segments

3 Low – reduces designated stream segment water supply by less than 10%

4 Medium – reduces designated stream segment water supply by more than 10%

5 High – reduces designated stream segment water supply by more than 50%

Environmental Impacts

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;

- Threatened and Endangered Species
- Environmental Water Needs
- Wildlife Habitat

- Cultural Resources
- Environmental Water Quality
- Bays and Estuaries

Table 5B-3. Environmental Impact Category Ranting Matrix

Threatened and Endangered Species	Rank	Environmental Water Needs	Wildlife Habitat	Cultural Resources	Environmental Water Quality	Bays and Estuaries
Number of species in county where strategy infrastructure occurs	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	

Threatened and Endangered Species refers to the number of designated rare, threatened, and endangered species located in each county as listed in the Texas Parks and Wildlife Department's Natural Diversity Database of Rare, Threatened, and Endangered Species as of 8-24-2015 located at http://tpwd.texas.gov/huntwild/wild/wildlife_diversity/txndd. Impacts to specific species will require additional assessment.

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 take into account 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%

4 Moderate negative – environmental water needs will be reduced by 10 to 30%

5 Significant negative - environmental water needs will be reduced by >30%

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

Cultural Resources 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%

4 Moderate negative – disturbance to cultural resources will be 10 to 20%

5 Significant negative - disturbance to cultural resources will be > 20%

Environmental Water Quality 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%

4 Moderate negative – water quality characteristics of existing environmental habitat will be negatively altered by < 10 to 30%

5 Significant negative - water quality characteristics of existing environmental habitat will be negatively altered by > 30%

Bays and Estuaries - Far West Texas 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.

This page intentionally left blank.

APPENDIX 5C
AUXILIARY WATER MANAGEMENT STRATEGY TABLES

This page intentionally left blank.

Auxiliary Water Management Strategy Tables

Table 5-6. Recommended Water Management Strategy Roll-Up Summary

County	Water User Group	Strategy	Source	2016 Strategy ID	Strategy Supply (Acre-Feet/Year)						Total Capital Cost (Table 5-3)
					2020	2030	2040	2050	2060	2070	
Brewster	Brewster County Other (Marathon WSSService)	Water loss audit and main-line repair	Conservation	E-1	65	65	65	65	65	65	$426,000
	Brewster County Other (Rio Grande Village BBNP)	Water loss audit and main-line repair	Conservation	E-2	6	6	6	6	6	6	$607,000
	Brewster County Other (Panther Junction BBNP Plt)	Water loss audit and main-line repair	Conservation	E-3	2	2	2	2	2	2	$759,000
Culberson	City of Van Horn	Water loss audit and main-line repair	Conservation	E-4	30	30	30	30	30	30	$1,197,000
	*Culberson County Mining	Additional groundwater wells	Rustler Aquifer	E-5	590	590	590	590	590	590	$608,000
		Additional groundwater well	West Texas Bolsons Aquifer / Upper Salt Basin	E-6	590	590	590	590	590	590	$675,000
El Paso	*Town of Anthony	Water loss audit and main-line repair	Conservation	E-7	7	7	7	7	7	7	$759,000
		Arsenic treatment facility	Mesilla Bolson Aquifer	E-8	2,800	2,800	2,800	2,800	2,800	2,800	$9,952,000
		Additional groundwater well	Hueco-Mesilla Bolson Aquifer	E-9	960	960	960	960	960	960	$1,244,471
	*City of El Paso (EPWU)	Municipal conservation programs	Conservation	E-10	1,870	2,110	1,160	2,550	5,530	5,910	$0
		Advanced purified water at the Haskell and NW WWTPs	Reuse Treated Wastewater	E-11			3,000	7,500	12,000	16,500	$291,800,000
		Advanced purified water at the Bustamante WWTP	Reuse Treated Wastewater	E-12	8,000	9,000	10,000	10,000	10,000	10,000	$94,096,000
		Recharge of Hueco Aquifer groundwater with treated surface water from Jonathan Rogers Plant	Rio Grande	E-13	5,000	5,000	5,000	5,000	5,000	5,000	$2,495,000
		Treatment & reuse of agricultural drain water	Agricultural Drain Water	E-14		2,700	2,700	2,700	2,700	2,700	$41,679,000
		Expansion of local well fields	Hueco-Mesilla Bolson Aquifer	E-15	3,880	7,760	11,640	15,520	19,400	23,280	$32,712,000
		Brackish Groundwater at the Jonathan Rogers WTP	Rio Grande Alluvium Aquifer	E-16			11,000	11,000	11,000	11,000	$65,865,000
		Expansion of the Kay Bailey Hutchison Desal Plant	Hueco Bolson Aquifer	E-17	1,260	2,520	2,520	2,520	2,520	2,520	$37,200,000

Table 5-6. (Continued) Recommended Water Management Strategy Roll-Up Summary

County	Water User Group	Strategy	Source	2016 Strategy ID	Strategy Supply (Acre-Feet/Year)						Total Capital Cost (Table 5-3)
					2020	2030	2040	2050	2060	2070	
El Paso	*City of El Paso (EPWU)	Groundwater from Hueco Ranch	Other Aquifer / Diablo Plateau	E-18			5,000	5,000	5,000	5,000	$155,858,000
		Groundwater from Southern Hudspeth County	Other Aquifer / Diablo Plateau	E-19	10,000	10,000	10,000	10,000	10,000	10,000	$98,980,000
		Expansion of the Jonathan Rogers WTP	Rio Grande	E-20	6,500	6,500	6,500	6,500	6,500	6,500	$95,186,653
		Riverside Regulating Reservoir	Rio Grande & Stormwater Run-off	E-21	6,500	6,500	6,500	6,500	6,500	6,500	$20,754,157
		Groundwater from Diablo Farms	Capitan Reef Complex Aquifer	E-22				10,000	10,000	10,000	$273,507,000
		Groundwater from Dell City area	Bone Spring-Victorio Peak Aquifer	E-23					10,000	20,000	$303,185,000
	*Lower Valley Water District	Public conservation education	Conservation	E-24	36	43	51	59	66	73	$0
		Purchased water from EPWU	EPWU Blended Source	E-25	2,453	3,228	3,965	4,734	5,500	6,227	$0
		Surface water treatment plant & transmission line	Rio Grande	E-26	6,700	6,700	6,700	6,700	6,700	6,700	$34,080,000
		Groundwater from proposed Well field	Other Aquifer / Rio Grande Alluvium Aquifer	E-27	6,800	6,800	6,800	6,800	6,800	6,800	$37,490,000
		Groundwater from proposed Well field	Hueco Bolson Aquifer	E-28	6,800	6,800	6,800	6,800	6,800	6,800	$41,070,000
		Wastewater treatment facility and ASR	Reuse Treated Wastewater	E-29	3,808	3,808	3,808	3,808	3,808	3,808	$18,108,000
	*City of Socorro	Public conservation education	Conservation	E-30	32	34	37	40	44	47	$0
		Purchased water from LVWD	EPWU Blended Source	E-31	217	488	757	1,069	1,406	1,732	$0
	*Horizon City	Public conservation education	Conservation	E-32	45	63	80	98	114	130	$0
		Purchased water from Horizon Regional MUD	Other Aquifer / Rio Grande Alluvium Aquifer	E-33	1,352	3,203	4,941	6,669	8,308	9,853	$0

Table 5-6. (Continued) Recommended Water Management Strategy Roll-Up Summary

County	Water User Group	Strategy	Source	2016 Strategy ID	Strategy Supply (Acre-Feet/Year)						Total Capital Cost (Table 5-3)
					2020	2030	2040	2050	2060	2070	
El Paso	*Horizon Regional MUD	Public conservation education	Conservation	E-34	37	50	63	76	88	99	$0
		Additional wells & expansion of desal plant	Hueco Bolson & Other Aquifer / Rio Grande Alluvium Aquifer	E-35	2,585	5,785	8,792	11,784	14,625	17,304	$56,443,000
	*Fort Bliss	Public conservation education	Conservation	E-36	16	17	17	18	18	19	$0
		Purchased water from EPWU	EPWU Blended Source	E-37				100	100	100	$0
	El Paso County Tornillo WID	Additional groundwater well & transmission line	Hueco Bolson Aquifer	E-38	333	333	333	333	333	333	$1,726,000
		Arsenic treatment facility	Hueco Bolson Aquifer	E-39	276	276	276	276	276	276	$3,114,000
	City of Vinton	High capacity water lines for improved distribution of water from EPWU	EPWU Blended Source	E-40	400	400	400	400	400	400	$4,192,000
	*El Paso County Other	Public conservation education	Conservation	E-41	0	9	8	8	8	7	$0
		Purchased water from EPWU	EPWU Blended Source	E-42	368	764	1,220	1,754	2,259	2,745	$0
	*El Paso County Irrigation (EPCWID #1)	Irrigation scheduling	Conservation	E-43	1,740	1,740	1,740	1,740	1,740	1,740	$0
		Tailwater reuse	Conservation	E-44	1,723	1,723	1,723	1,723	1,723	1,723	$0
		Improvements to water district delivery system	Conservation	E-45	25,000	25,000	25,000	25,000	25,000	25,000	$157,777,783
	*El Paso County Manufacturing	Purchased water from EPWU	EPWU Blended Source	E-46	8,841	9,968	11,058	11,985	13,461	15,050	$0
	*El Paso County Mining	Additional groundwater wells	Hueco-Mesilla Bolson Aquifer	E-47				242	987	1,833	$969,000
	*El Paso County Steam Electric Power	Purchased water from EPWU	EPWU Blended Source	E-48	3,651	4,825	6,255	7,998	10,124	12,651	$0
Hudspeth	Hudspeth County Other (Dell City)	Water loss audit and main-line repair	Conservation	E-49	1	1	1	1	1	1	$1,614,000
		Brackish groundwater desal facility	Bone Spring-Victorio Peak Aquifer	E-50	111	111	111	111	111	111	$1,299,000

Table 5-6. (Continued) Recommended Water Management Strategy Roll-Up Summary

County	Water User Group	Strategy	Source	2016 Strategy ID	Strategy Supply (Acre-Feet/Year)						Total Capital Cost (Table 5-3)
					2020	2030	2040	2050	2060	2070	
Hudspeth	Hudspeth County Other (Fort Hancock WCID)	Water loss audit and main-line repair	Conservation	E-51	3	3	3	3	3	3	$292,000
		Additional well & RO treatment facility	Hueco-Mesilla Bolson Aquifer	E-52	565	565	565	565	565	565	$6,109,000
	Hudspeth County Other (City of Sierra Blanca - Hudspeth Co. WCID #1)	Additional transmission line to supply connections outside of the District	West Texas Bolsons Aquifer / Salt Basin	E-53	351	351	351	351	351	351	$1,429,000
	*Hudspeth Irrigation (HCCRD #1)	Additional groundwater wells	Other Aquifer / Rio Grande Alluvium Aquifer	E-54	230	230	230	230	230	230	$173,000
	Hudspeth Irrigation (HCUWCD #1)	Irrigation scheduling	Conservation	E-55	3,535	3,535	3,535	3,535	3,535	3,535	$0
		Tailwater reuse	Conservation	E-56	589	589	589	589	589	589	$0
	*Hudspeth County Mining	Additional groundwater well	West Texas Bolsons Aquifer / Eagle Flat	E-57	30	30	30	30	30	30	$449,000
Jeff Davis	Fort Davis WSC	Additional groundwater well	Igneous Aquifer	E-58	274	274	274	274	274	274	$507,000
		Additional transmission line to connect Fort Davis WSC to Fort Davis Estates	Igneous Aquifer	E-59	114	114	114	114	114	114	$1,068,000
	Jeff Davis County Other (Town of Valentine)	Additional groundwater well	West Texas Bolsons Aquifer / Salt Basin	E-60	65	65	65	65	65	65	$402,808
Presidio	City of Marfa	Additional groundwater well	Igneous Aquifer	E-61	785	785	785	785	785	785	$1,143,000
	City of Presidio	Water loss audit and main-line repair	Conservation	E-62	9	9	9	9	9	9	$2,172,000
		Additional groundwater well	West Texas Bolsons Aquifer / Presidio-Redford	E-63	120	120	120	120	120	120	$1,861,000
Terrell	*Terrell County Mining	Additional groundwater wells	Edwards-Trinity (Plateau) Aquifer	E-64	0	0	0	0	0	0	$738,000
				Totals	**128,054**	**145,980**	**177,676**	**206,835**	**238,670**	**268,191**	**1,903,771,872**

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

Table 5-7. Management Supply Factor

	2020	2030	2040	2050	2060	2070
Alpine	1.1	1.1	1.1	1.1	1.1	1.1
Anthony	6.8	5.8	5.1	4.6	4.1	3.8
Clint	3.0	3.1	3.3	3.3	3.3	3.3
County-Other, Brewster	2.0	2.0	2.0	1.9	1.9	1.9
County-Other, Culberson	2.2	2.0	2.0	1.9	1.9	1.9
County-Other, El Paso	1.0	1.0	1.0	1.0	1.0	1.0
County-Other, Hudspeth	5.6	5.3	5.4	5.3	5.3	5.3
County-Other, Jeff Davis	4.4	4.5	4.7	4.7	4.8	4.8
County-Other, Presidio	2.4	2.2	2.0	1.9	1.7	1.6
County-Other, Terrell	3.2	3.2	3.2	3.2	3.2	3.2
El Paso	1.4	1.3	1.4	1.4	1.4	1.4
El Paso County Tornillo WID	3.9	4.0	4.1	4.1	4.1	4.1
El Paso WCID #4	1.3	1.3	1.4	1.4	1.3	1.3
Fort Bliss	1.1	1.1	1.1	1.1	1.1	1.1
Fort Davis	2.5	2.5	2.5	2.6	2.6	2.6
Horizon City	1.1	1.0	1.0	1.0	1.0	1.0
Horizon Regional MUD	4.9	3.6	2.9	2.4	2.1	1.8
Irrigation, Brewster	1.4	1.4	1.4	1.4	1.4	1.5
Irrigation, Culberson	1.0	1.0	1.0	0.9	0.9	0.9
Irrigation, El Paso	0.8	0.8	0.8	0.9	0.9	0.9
Irrigation, Hudspeth	0.5	0.5	0.5	0.5	0.5	0.5
Irrigation, Jeff Davis	1.3	1.3	1.3	1.3	1.3	1.3
Irrigation, Presidio	1.9	2.0	2.0	2.1	2.1	2.1
Irrigation, Terrell	2.9	3.0	3.0	3.1	3.2	3.2
Livestock, Brewster	1.0	1.0	1.0	1.0	1.0	1.0
Livestock, Culberson	1.0	1.0	1.0	1.0	1.0	1.0
Livestock, El Paso	1.0	1.0	1.0	1.0	1.0	1.0
Livestock, Hudspeth	1.0	1.0	1.0	1.0	1.0	1.0
Livestock, Jeff Davis	1.0	1.0	1.0	1.0	1.0	1.0
Livestock, Presidio	1.0	1.0	1.0	1.0	1.0	1.0
Livestock, Terrell	1.0	1.0	1.0	1.0	1.0	1.0
Lower Valley WD	7.7	6.6	5.8	5.1	4.7	4.3
Manufacturing, Brewster	1.0	1.0	1.0	1.0	1.0	1.0
Manufacturing, El Paso	1.0	1.0	1.0	1.0	1.0	1.0
Manufacturing, Hudspeth	5.0	5.0	5.0	5.0	5.0	5.0
Marfa	4.3	4.1	3.8	3.6	3.3	3.2

Table 5-7. (Continued) Management Supply Factor

Mining, Culberson	2.8	1.1	1.0	1.3	1.7	2.2
Mining, El Paso	1.4	1.2	1.1	1.1	1.0	1.0
Mining, Hudspeth	1.1	1.1	1.1	1.1	1.0	1.0
Mining, Presidio	1.0	0.0	0.0	0.0	0.0	0.0
Mining, Terrell	0.3	0.3	0.3	0.4	0.5	0.6
Presidio	5.6	5.4	5.2	4.9	4.6	4.4
Sanderson	2.6	2.6	2.6	2.6	2.6	2.6
Sierra Blanca	5.6	5.2	5.1	5.0	5.0	5.0
Socorro	1.0	1.0	1.0	1.0	1.0	1.0
Steam Electric Power, El Paso	1.0	1.0	1.0	1.0	1.0	1.0
Van Horn	2.1	1.9	1.9	1.8	1.8	1.8
Vinton	3.2	3.1	3.1	3.0	2.9	2.8

This page intentionally left blank.

CHAPTER 6

REGIONAL WATER PLAN IMPACTS AND CONSISTENCY WITH PROTECTION OF WATER, AGRICULTURAL AND NATURAL RESOURCES

This page intentionally left blank.

6 REGIONAL WATER PLAN IMPACTS AND CONSISTENCY WITH PROTECTION OF WATER AGRICULTURAL AND NATURAL RESOURCES

Chapter 6 describes how this *2016 Plan* is consistent with the long-term protection of water resources, agricultural resources, and natural resources that are important to Far West Texas; and describes how those resources are protected through the regional water planning process. In addition, the socioeconomic impact of not meeting water supply needs within the Region are discussed in an analysis report prepared by the Texas Water Development Board and presented in Appendix 6A at the end of this chapter.

6.1 PROTECTION OF WATER RESOURCES

Water resources in Far West Texas as described in Chapter 3 include groundwater in numerous aquifers and surface water occurring in the Rio Grande and Pecos River basins. The numerous springs, which represent an interrelational transition point between groundwater and surface water, are also recognized in Chapter 1, Section 1.6 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 were developed through a water availability model process (WAM) 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 Modeled Available Groundwater (MAG) volumes that may be produced on an average annual basis to achieve a Desire Future Condition (DFC) as adopted by Groundwater Management Areas (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.

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 5-4 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 Far West Texas, as described in Chapter 1, Sections 1.2.8 and 1.3.2, includes the raising of crops and livestock, as well as a multitude of businesses that support this industry. TWDB's socio-economic analysis (provided in Appendix 6A) reports that in 2011 the Region generated about $35 billion in gross state product associated with about 406,000 jobs. However, two of the seven counties in the Region are projected to experience water shortages in the irrigated agricultural use category for one or more decades within the planning horizon. Estimated impacts to this water use category appear in Table 6-1. Note that tax collection impacts were not estimated for this water use category. A negative tax impact was surmised, primarily due to past subsidies from the federal government. Two factors led to reporting any federal tax impacts:

1 Federal support (subsidies) has lessened greatly since data was collected in the *2011 Plan.*

2 It was not considered realistic to report increasing tax revenue collections for a drought of record.

None of the seven counties in the Region are projected to experience water shortages in the livestock water use category for one or more decades in the planning horizon.

Water is an absolute necessity to maintaining the agricultural industry and its use represents over three-fourths of all the water used in the Region. 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.

The *Far West Texas Water Plan* provides irrigation strategy recommendations in Chapter 5 that address water conservation management practices. If implemented, these practices will result in reduced water application per acre irrigated. Also, non-agricultural strategies provided in Chapter 5 include an analysis of potential impact to agricultural interests.

An interim project was performed in 2009 to evaluate the effectiveness of previously recommended irrigation practices. A summary of this report titled " Evaluation of Irrigation Efficiency Strategies for Far West Texas: Feasibility, Water Savings and Cost Considerations" is available on the Rio Grande COG web site at http://www.riocog.org.

Table 6-1. Impacts of Water Shortages on Irrigation ($ millions)

WUG	2020	2030	2040	2050	2060	2070
Irrigation	$30	$28	$25	$24	$22	$20
Job Losses	647	610	547	506	464	427

* Year 2013 dollars rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.

6.3 PROTECTION OF NATURAL RESOURCES

The Far West Texas Water Planning Group has adopted a stance toward the protection of natural resources. Natural resources are defined in Chapter 1, Section 1.2.9 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. In Chapter 8 describes recommended ecologically unique river and stream segments, while Appendix 8I of the *2011 Plan* presents the Texas Parks and Wildlife Department recommended Ecologically Significant River and Stream Segments.

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.

The Far West Texas Water Planning Group previously (*2006 and 2011 Plans*) recommended as "Ecologically Unique River and Stream Segments" three streams that lie within the boundaries of State-managed properties, three within National Park boundaries, and specified streams managed by the Texas Nature Conservancy. The Water Planning Group has added in this *2016 Plan* Terlingua Creek in Big Bend National Park to its list of recommended stream segments. A quantitative analysis conducted to assess potential impacts of the *Plan* on these segments found that all recommended strategies listed in Chapter 5 have no influence on water resources in the vicinity of these segments. Although the Planning Group chooses to respect the privacy of private lands by not recommending stream segments on these properties, the Group recognizes and applauds the conservation work that is undertaken on a daily basis by the majority of these private landowners.

APPENDIX 6A
SOCIOECONOMIC IMPACT OF UNMET WATER NEEDS

This page intentionally left blank.

Socioeconomic Impacts of Projected Water Shortages

for the Region E Regional Water Planning Area

Prepared in Support of the 2016 Region E Regional Water Plan

Texas Water Development Board

Dr. John R. Ellis
Water Use Projections & Planning Division
Texas Water Development Board

Yun Cho, Team Lead
Water Use Projections & Planning Division
Texas Water Development Board

Kevin Kluge, Manager
Water Use Projections & Planning Division
Texas Water Development Board

August, 2015

Table of Contents

Executive Summary

Evaluating the social and economic impacts of not meeting identified water needs is a required part of the regional water planning process. The Texas Water Development Board (TWDB) estimates those impacts for regional water planning groups, and summarizes the impacts in the state water plan. The analysis presented is for the Region E Regional Water Planning Group.

Based on projected water demands and existing water supplies, the Region E planning group identified water needs (potential shortages) that would occur within its region under a repeat of the drought of record for six water use categories. The TWDB then estimated the socioeconomic impacts of those needs—if they are not met—for each water use category and as an aggregate for the region.

The analysis was performed using an economic modeling software package, IMPLAN (Impact for Planning Analysis), as well as other economic analysis techniques, and represents a snapshot of socioeconomic impacts that may occur during a single year during a drought of record within each of the planning decades. For each water use category, the evaluation focused on estimating income losses and job losses. The income losses represent an approximation of gross domestic product (GDP) that would be foregone if water needs are not met.

The analysis also provides estimates of financial transfer impacts, which include tax losses (state, local, and utility tax collections); water trucking costs; and utility revenue losses. In addition, social impacts were estimated, encompassing lost consumer surplus (a welfare economics measure of consumer wellbeing); as well as population and school enrollment losses.

It is estimated that not meeting the identified water needs in Region E would result in an annually combined lost income impact of approximately $1.7 billion in 2020, increasing to $3.5 billion in 2070 (Table ES-1). In 2020, the region would lose approximately 11,400 jobs, and by 2070 job losses would increase to approximately 25,200.

All impact estimates are in year 2013 dollars and were calculated using a variety of data sources and tools including the use of a region-specific IMPLAN model, data from the TWDB annual water use estimates, the U.S. Census Bureau, Texas Agricultural Statistics Service, and Texas Municipal League.

Table ES-1: Region E Socioeconomic Impact Summary

Regional Economic Impacts	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$1,674	$1,951	$2,283	$2,610	$3,020	$3,465
Job losses	11,408	13,285	15,978	18,659	21,873	25,201
Financial Transfer Impacts	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Tax losses on production and imports ($ millions)*	$88	$103	$120	$136	$156	$178
Water trucking costs ($ millions)*	-	-	-	$0	$0	$2
Utility revenue losses ($ millions)*	$10	$18	$26	$47	$61	$93
Utility tax revenue losses ($ millions)*	$0	$0	$0	$1	$1	$2
Social Impacts	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Consumer surplus losses ($ millions)*	$5	$14	$27	$46	$64	$87
Population losses	2,095	2,439	2,934	3,426	4,016	4,627
School enrollment losses	388	451	543	634	743	856

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

1 Introduction

Water shortages during a repeat of the drought of record would likely curtail or eliminate certain economic activity in businesses and industries that rely heavily on water. Insufficient water supplies could not only have an immediate and real impact on existing businesses and industry, but they could also adversely and chronically affect economic development in Texas. From a social perspective, water supply reliability is critical as well. Shortages could disrupt activity in homes, schools and government and could adversely affect public health and safety. For these reasons, it is important to evaluate and understand how water supply shortages during drought could impact communities throughout the state.

Administrative rules (31 Texas Administrative Code §357.33 (c)) require that regional water planning groups evaluate the social and economic impacts of not meeting water needs as part of the regional water planning process, and rules direct the TWDB staff to provide technical assistance upon request. Staff of the TWDB's Water Use, Projections, & Planning Division designed and conducted this analysis in support of the Region E Regional Water Planning Group.

This document summarizes the results of the analysis and discusses the methodology used to generate the results. Section 1 summarizes the water needs calculation performed by the TWDB based on the regional water planning group's data. Section 2 describes the methodology for the impact assessment and discusses approaches and assumptions specific to each water use category (i.e., irrigation, livestock, mining, steam-electric, municipal and manufacturing). Section 3 presents the results for each water use category with results summarized for the region as a whole. Appendix A presents details on the socioeconomic impacts by county.

1.1 Identified Regional Water Needs (Potential Shortages)

As part of the regional water planning process, the TWDB adopted water demand projections for each water user group (WUG) with input from the planning groups. WUGs are composed of cities, utilities, combined rural areas (designated as county-other), and the county-wide water use of irrigation, livestock, manufacturing, mining and steam-electric power. The demands are then compared to the existing water supplies of each WUG to determine potential shortages, or needs, by decade. Existing water supplies are legally and physically accessible for immediate use in the event of drought. Projected water demands and existing supplies are compared to identify either a surplus or a need for each WUG.

Table 1-1 summarizes the region's identified water needs in the event of a repeat of the drought of record. Demand management, such as conservation, or the development of new infrastructure to increase supplies are water management strategies that may be recommended by the planning group to meet those needs. This analysis assumes that no strategies are implemented, and that the identified needs correspond to future water shortages. Note that projected water needs generally increase over time, primarily due to anticipated population and economic growth. To provide a general sense of proportion, total projected needs as an overall percentage of total demand by water use category are presented in aggregate in Table 1-1. Projected needs for individual water user groups within the aggregate vary greatly, and may reach 100% for a given WUG and water use category. Detailed water needs by WUG and county appear in Chapter 4 of the 2016 Region E Regional Water Plan.

Table 1-1 Regional Water Needs Summary by Water Use Category

Water Use Category		2020	2030	2040	2050	2060	2070
Irrigation	Water Needs (acre-feet per year)	170,012	162,417	148,458	138,978	130,982	123,894
	% of the category's total water demand	36%	35%	33%	31%	30%	29%
Livestock	Water Needs (acre-feet per year)	-	-	-	-	-	-
	% of the category's total water demand	-	-	-	-	-	-
Manufacturing	Water Needs (acre-feet per year)	8,841	9,968	11,058	11,985	13,461	15,050
	% of the category's total water demand	55%	58%	60%	62%	65%	67%
Mining	Water Needs (acre-feet per year)	740	1,577	1,694	1,521	1,885	2,440
	% of the category's total water demand	12%	22%	22%	19%	22%	27%
Municipal	Water Needs (acre-feet per year)	5,623	10,265	14,734	28,319	43,442	58,011
	% of the category's total water demand	4%	7%	9%	15%	22%	27%
Steam-electric power	Water Needs (acre-feet per year)	3,651	4,825	6,255	7,998	10,124	12,651
	% of the category's total water demand	53%	59%	66%	71%	75%	79%
Total water needs		**188,867**	**189,052**	**182,199**	**188,801**	**199,894**	**212,046**

2 Economic Impact Assessment Methodology Summary

This portion of the report provides a summary of the methodology used to estimate the potential economic impacts of future water shortages. The general approach employed in the analysis was to obtain estimates for income and job losses on the smallest geographic level that the available data would support, tie those values to their accompanying historic water use estimate (volume), and thereby determine a maximum impact per acre-foot of shortage for each of the socioeconomic measures. The calculations of economic impacts were based on the overall composition of the economy using many underlying economic "sectors." Sectors in this analysis refer to one or more of the 440 specific production sectors of the economy designated within IMPLAN (Impact for Planning Analysis), the economic impact modeling software used for this assessment. Economic impacts within this report are estimated for approximately 310 of those sectors, with the focus on the more water intense production sectors. The economic impacts for a single water use category consist of an aggregation of impacts to multiple related economic sectors.

2.1 Impact Assessment Measures

A required component of the regional and state water plans is to estimate the potential economic impacts of shortages due to a drought of record. Consistent with previous water plans, several key variables were estimated and are described in Table 2-1.

Table 2-1 Socioeconomic Impact Analysis Measures

Regional Economic Impacts	Description
Income losses - value added	The value of output less the value of intermediate consumption; it is a measure of the contribution to GDP made by an individual producer, industry, sector, or group of sectors within a year. For a shortage, value added is a measure of the income losses to the region, county, or WUG and includes the direct, indirect and induced monetary impacts on the region.
Income losses - electrical power purchase costs	Proxy for income loss in the form of additional costs of power as a result of impacts of water shortages.
Job losses	Number of part-time and full-time jobs lost due to the shortage.
Financial Transfer Impacts	**Description**
Tax losses on production and imports	Sales and excise taxes (not collected due to the shortage), customs duties, property taxes, motor vehicle licenses, severance taxes, other taxes, and special assessments less subsidies.
Water trucking costs	Estimate for shipping potable water.
Utility revenue losses	Foregone utility income due to not selling as much water.
Utility tax revenue losses	Foregone miscellaneous gross receipts tax collections.
Social Impacts	**Description**
Consumer surplus losses	A welfare measure of the lost value to consumers accompanying less water use.
Population losses	Population losses accompanying job losses.
School enrollment losses	School enrollment losses (K-12) accompanying job losses.

2.1.1 Regional Economic Impacts

Two key measures were included within the regional economic impacts classification: income losses and job losses. Income losses presented consist of the sum of value added losses and additional purchase costs of electrical power. Job losses are also presented as a primary economic impact measure.

Income Losses - Value Added Losses

Value added is the value of total output less the value of the intermediate inputs also used in production of the final product. Value added is similar to Gross Domestic Product (GDP), a familiar measure of the productivity of an economy. The loss of value added due to water shortages was estimated by input-output analysis using the IMPLAN software package, and includes the direct, indirect, and induced monetary impacts on the region.

Income Losses - Electric Power Purchase Costs

The electrical power grid and market within the state is a complex interconnected system. The industry response to water shortages, and the resulting impact on the region, are not easily modeled using traditional input/output impact analysis and the IMPLAN model. Adverse impacts on the region will occur, and were represented in this analysis by the additional costs associated with power purchases from other generating plants within the region or state. Consequently, the analysis employed additional power purchase costs as a proxy for the value added impacts for that water use category, and these are included as a portion of the overall income impact for completeness.

For the purpose of this analysis, it was assumed that power companies with insufficient water will be forced to purchase power on the electrical market at a projected higher rate of 5.60 cents per kilowatt hour. This rate is based upon the average day-ahead market purchase price of electricity in Texas from the recent drought period in 2011.

Job Losses

The number of jobs lost due to the economic impact was estimated using IMPLAN output associated with the water use categories noted in Table 1-1. Because of the difficulty in predicting outcomes and a lack of relevant data, job loss estimates were not calculated for the steam-electric power production or for certain municipal water use categories.

2.1.2 Financial Transfer Impacts

Several of the impact measures estimated within the analysis are presented as supplemental information, providing additional detail concerning potential impacts on a sub-portion of the economy or government. Measures included in this category include lost tax collections (on production and imports), trucking costs for imported water, declines in utility revenues, and declines in utility tax revenue collected by the state. Many of these measures are not solely adverse, with some having both positive and negative impacts. For example, cities and residents would suffer if forced to pay large costs for trucking in potable water. Trucking firms, conversely, would benefit from the transaction. Additional detail for each of these measures follows.

Tax Losses on Production and Imports

Reduced production of goods and services accompanying water shortages adversely impacts the collection of taxes by state and local government. The regional IMPLAN model was used to estimate reduced tax collections associated with the reduced output in the economy.

Water Trucking Costs

In instances where water shortages for a municipal water user group were estimated to be 80 percent or more of water demands, it was assumed that water would be trucked in to support basic consumption and sanitation needs. For water shortages of 80 percent or greater, a fixed cost of $20,000 per acre-foot of water was calculated and presented as an economic cost. This water trucking cost was applied for both the residential and non-residential portions of municipal water needs and only impacted a small number of WUGs statewide.

Utility Revenue Losses

Lost utility income was calculated as the price of water service multiplied by the quantity of water not sold during a drought shortage. Such estimates resulted from city-specific pricing data for both water and wastewater. These water rates were applied to the potential water shortage to determine estimates of lost utility revenue as water providers sold less water during the drought due to restricted supplies.

Utility Tax Losses

Foregone utility tax losses included estimates of uncollected miscellaneous gross receipts taxes. Reduced water sales reduce the amount of utility tax that would be collected by the State of Texas for water and wastewater service sales.

2.1.3 Social Impacts

Consumer Surplus Losses of Municipal Water Users

Consumer surplus loss is a measure of impact to the wellbeing of municipal water users when their water use is restricted. Consumer surplus is the difference between how much a consumer is willing and able to pay for the commodity (i.e., water) and how much they actually have to pay. The difference is a benefit to the consumer's wellbeing since they do not have to pay as much for the commodity as they would be willing to pay. However, consumer's access to that water may be limited, and the associated consumer surplus loss is an estimate of the equivalent monetary value of the negative impact to the consumer's wellbeing, for example, associated with a diminished quality of their landscape (i.e., outdoor use). Lost consumer surplus estimates for reduced outdoor and indoor use, as well as residential and commercial/institutional demands, were included in this analysis. Consumer surplus is an attempt to measure effects on wellbeing by monetizing those effects; therefore, these values should not be added to the other monetary impacts estimated in the analysis.

Lost consumer surplus estimates varied widely by location and type. For a 50 percent shortage, the estimated statewide consumer surplus values ranged from $55 to $2,500 per household (residential use), and from $270 to $17,400 per firm (non-residential).

Population and School Enrollment Losses

Population losses due to water shortages, as well as the related loss of school enrollment, were based upon the job loss estimates and upon a recent study of job layoffs and the resulting adjustment of the labor market, including the change in population.[1] The study utilized Bureau of Labor Statistics data regarding layoffs between 1996 and 2013, as well as Internal Revenue Service data regarding migration, to model an estimate of the change in the population as the result of a job layoff event. Layoffs impact both out-migration, as well as in-migration into an area, both of which can negatively affect the population of an area. In addition, the study found that a majority of those who did move following a layoff moved to another labor market rather than an adjacent county. Based on this study, a simplified ratio of job and net population losses was calculated for the state as a whole: for every 100 jobs lost, 18 people were assumed to move out of the area. School enrollment losses were estimated as a proportion of the population lost.

2.2 Analysis Context

The context of the economic impact analysis involves situations where there are physical shortages of surface or groundwater due to drought of record conditions. Anticipated shortages may be nonexistent in earlier decades of the planning horizon, yet population growth or greater industrial, agricultural or other sector demands in later decades may result in greater overall demand, exceeding the existing supplies. Estimated socioeconomic impacts measure what would happen if water user groups experience water shortages for a period of one year. Actual socioeconomic impacts would likely become larger as drought of record conditions persist for periods greater than a single year.

2.2.1 IMPLAN Model and Data

Input-Output analysis using the IMPLAN (Impact for Planning Analysis) software package was the primary means of estimating value added, jobs, and taxes. This analysis employed county and regional level models to determine key impacts. IMPLAN is an economic impact model, originally developed by the U.S. Forestry Service in the 1970's to model economic activity at varying geographic levels. The model is currently maintained by the Minnesota IMPLAN Group (MIG Inc.) which collects and sells county and state specific data and software. The year 2011 version of IMPLAN, employing data for all 254 Texas counties, was used to provide estimates of value added, jobs, and taxes on production for the economic sectors associated with the water user groups examined in the study. IMPLAN uses 440 sector-specific Industry Codes, and those that rely on water as a primary input were assigned to their relevant planning water user categories (manufacturing, mining, irrigation, etc.). Estimates of value added for a water use category were obtained by summing value added estimates across the relevant IMPLAN sectors

---

[1] Foote, Andrew, Grosz, Michel, Stevens, Ann. "Locate Your Nearest Exit: Mass Layoffs and Local Labor Market Response." University of California, Davis. April 2015. http://paa2015.princeton.edu/uploads/150194

associated with that water use category. Similar calculations were performed for the job and tax losses on production and import impact estimates.

Note that the value added estimates, as well as the job and tax estimates from IMPLAN, include three components:

- *Direct effects* representing the initial change in the industry analyzed;
- *Indirect effects* that are changes in inter-industry transactions as supplying industries respond to reduced demands from the directly affected industries; and,
- *Induced effects* that reflect changes in local spending that result from reduced household income among employees in the directly and indirectly affected industry sectors.

2.2.2 Elasticity of Economic Impacts

The economic impact of a water need is based on the relative size of the water need to the water demand for each water user group (Figure 2-1). Smaller water shortages, for example, less than 5 percent, were anticipated to result in no initial negative economic impact because water users are assumed to have a certain amount of flexibility in dealing with small shortages. As a water shortage deepens, however, such flexibility lessens and results in actual and increasing economic losses, eventually reaching a representative maximum impact estimate per unit volume of water. To account for such ability to adjust, an elasticity adjustment function was used in estimating impacts for several of the measures. Figure 2-1 illustrates the general relationship for the adjustment functions. Negative impacts are assumed to begin accruing when the shortage percentage reaches the lower bound b1 (10 percent in Figure 2-1), with impacts then increasing linearly up to the 100 percent impact level (per unit volume) once the upper bound for adjustment reaches the b2 level shortage (50 percent in Figure 2-1 example).

Initially, the combined total value of the three value added components (direct, indirect, and induced) was calculated and then converted into a per acre-foot economic value based on historical TWDB water use estimates within each particular water use category. As an example, if the total, annual value added for livestock in the region was $2 million and the reported annual volume of water used in that industry was 10,000 acre-feet, the estimated economic value per acre-foot of water shortage would be $200 per acre-foot. Negative economic impacts of shortages were then estimated using this value as the maximum impact estimate ($200 per acre-foot in the example) applied to the anticipated shortage volume in acre-feet and adjusted by the economic impact elasticity function. This adjustment varied with the severity as percentage of water demand of the anticipated shortage. If one employed the sample elasticity function shown in Figure 2-1, a 30% shortage in the water use category would imply an economic impact estimate of 50% of the original $200 per acre-foot impact value (i.e., $100 per acre-foot).

Such adjustments were not required in estimating consumer surplus, nor for the estimates of utility revenue losses or utility tax losses. Estimates of lost consumer surplus relied on city-specific demand curves with the specific lost consumer surplus estimate calculated based on the relative percentage of the city's water shortage. Estimated changes in population as well as changes in school enrollment were indirectly related to the elasticity of job losses.

Assumed values for the bounds b1 and b2 varied with water use category under examination and are presented in Table 2-2.

Figure 2-1 Example Economic Impact Elasticity Function (as applied to a single water user's shortage)

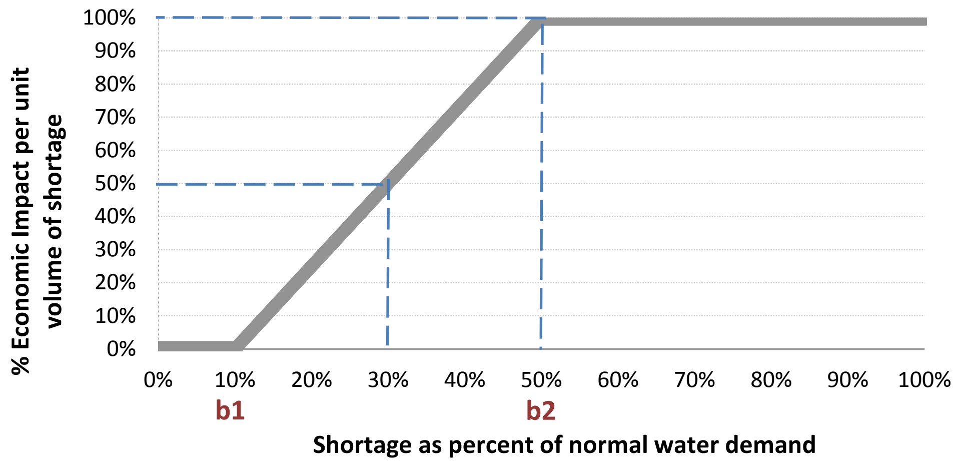


Table 2-2 Economic Impact Elasticity Function Lower and Upper Bounds

Water use category	Lower Bound (b1)	Upper Bound (b2)
Irrigation	5%	50%
Livestock	5%	10%
Manufacturing	10%	50%
Mining	10%	50%
Municipal (non-residential water intensive)	50%	80%
Steam-electric power	20%	70%

2.3 Analysis Assumptions and Limitations

Modeling of complex systems requires making assumptions and accepting limitations. This is particularly true when attempting to estimate a wide variety of economic impacts over a large geographic area and into future decades. Some of the key assumptions and limitations of the methodology include:

1. The foundation for estimating socioeconomic impacts of water shortages resulting from a drought are the water needs (potential shortages) that were identified as part of the regional water planning process. These needs have some uncertainty associated with them, but serve as a reasonable basis for evaluating potential economic impacts of a drought of record event.

2. All estimated socioeconomic impacts are snapshot estimates of impacts for years in which water needs were identified (i.e., 2020, 2030, 2040, 2050, 2060, and 2070). The estimates are independent and distinct "what if" scenarios for each particular year, and water shortages are assumed to be temporary events resulting from severe drought conditions. The evaluation assumed that no recommended water management strategies are implemented. In other words, growth occurs, future shocks are imposed on an economy at 10-year intervals, and the resulting impacts are estimated. Note that the estimates presented were not cumulative (i.e., summing up expected impacts from today up to the decade noted), but were simply an estimate of the magnitude of annual socioeconomic impacts should a drought of record occur in each particular decade based on anticipated supplies and demands for that same decade.

3. Input-output models such as IMPLAN rely on a static profile of the structure of the economy as it appears today. This presumes that the relative contributions of all sectors of the economy would remain the same, regardless of changes in technology, supplies of limited resources, and other structural changes to the economy that may occur into the future. This was a significant assumption and simplification considering the 50-year time period examined in this analysis. To presume an alternative future economic makeup, however, would entail positing many other major assumptions that would very likely generate as much or more error.

4. This analysis is not a cost-benefit analysis. That approach to evaluating the economic feasibility of a specific policy or project employs discounting future benefits and costs to their present value dollars using some assumed discount rate. The methodology employed in this effort to estimate the economic impacts of future water shortages did not use any discounting procedures to weigh future costs differently through time.

5. Monetary figures are reported in constant year 2013 dollars.

6. Impacts are annual estimates. The estimated economic model does not reflect the full extent of impacts that might occur as a result of persistent water shortages occurring over an extended duration. The drought of record in most regions of Texas lasted several years.

7. Value added estimates are the primary estimate of the economic impacts within this report. One may be tempted to add consumer surplus impacts to obtain an estimate of total adverse economic impacts to the region, but the consumer surplus measure represents the change to the wellbeing of households (and other water users), not an actual change in the flow of dollars through the economy. The two categories (value added and consumer surplus) are both valid impacts but should not be summed.

8. The value added, jobs, and taxes on production and import impacts include the direct, indirect and induced effects described in Section 2.2.1. Population and school enrollment losses also indirectly include such effects as they are based on the associated losses in employment. The remaining measures (consumer surplus, utility revenue, utility taxes, additional electrical power purchase costs, and potable water trucking costs), however, do not include any induced or indirect effects.

9. The majority of impacts estimated in this analysis may be considered smaller than those that might occur under drought of record conditions. Input-output models such as IMPLAN only capture “backward linkages” on suppliers (including households that supply labor to directly affected industries). While this is a common limitation in these types of economic impact modeling efforts, it is important to note that “forward linkages” on the industries that use the outputs of the directly affected industries can also be very important. A good example is impacts on livestock operators. Livestock producers tend to suffer substantially during droughts, not because there is not enough water for their stock, but because reductions in available pasture and higher prices for purchased hay have significant economic effects on their operations. Food processors could be in a similar situation if they cannot get the grains or other inputs that they need. These effects are not captured in IMPLAN, which is one reason why the impact estimates are likely conservative.

10. The methodology did not capture “spillover” effects between regions – or the secondary impacts that occur outside of the region where the water shortage is projected to occur.

11. The model did not reflect dynamic economic responses to water shortages as they might occur, nor does the model reflect economic impacts associated with a recovery from a drought of record including:
    a. The likely significant economic rebound to the landscaping industry immediately following a drought;
    b. The cost and years to rebuild liquidated livestock herds (a major capital item in that industry);
    c. Direct impacts on recreational sectors (i.e., stranded docks and reduced tourism); or,
    d. Impacts of negative publicity on Texas’ ability to attract population and business in the event that it was not able to provide adequate water supplies for the existing economy.

12. Estimates for job losses and the associated population and school enrollment changes may exceed what would actually occur. In practice, firms may be hesitant to lay off employees, even in difficult economic times. Estimates of population and school enrollment changes are based on regional evaluations and therefore do not accurately reflect what might occur on a statewide basis.

13. The results must be interpreted carefully. It is the general and relative magnitudes of impacts as well as the changes of these impacts over time that should be the focus rather than the absolute numbers. Analyses of this type are much better at predicting relative percent differences brought about by a shock to a complex system (i.e., a water shortage) than the precise size of an impact. To illustrate, assuming that the estimated economic impacts of a drought of record on the manufacturing and mining water user categories are $2 and $1 million, respectively, one should be more confident that the economic impacts on manufacturing are twice as large as those on mining and that these impacts will likely be in the millions of dollars. But one should have less confidence that the actual total economic impact experienced would be $3 million.

3 Analysis Results

This section presents a breakdown of the results of the regional analysis for Region E. Projected economic impacts for six water use categories (irrigation, livestock. municipal, manufacturing, mining, and steam-electric power) are also reported by decade.

3.1 Overview of the Regional Economy

Table 3-1 presents the 2011 economic baseline as represented by the IMPLAN model and adjusted to 2013 dollars for Region E. In year 2011, Region E generated about $35 billion in gross state product associated with about 406,000 jobs based on the 2011 IMPLAN data. These values represent an approximation of the current regional economy for a reference point.

Table 3-1 Region E Economy

Income($ millions)*	Jobs	Taxes on production and imports ($ millions)
$35,009	**406,178**	**$2,400**

***Year 2013 dollars based on 2011 IMPLAN model value added estimates for the region.**

The remainder of Section 3 presents estimates of potential economic impacts for each water use category that could reasonably be expected in the event of water shortages associated with a drought of record and if no recommended water management strategies were implemented.

3.2 Impacts for Irrigation Water Shortages

Two of the 7 counties in the region are projected to experience water shortages in the irrigated agriculture water use category for one or more decades within the planning horizon. Estimated impacts to this water use category appear in Table 3-2. Note that tax collection impacts were not estimated for this water use category. IMPLAN data indicates a negative tax impact (i.e., increased tax collections) for the associated production sectors, primarily due to past subsidies from the federal government. Two factors led to excluding any reported tax impacts: 1) Federal support (subsidies) has lessened greatly since the year 2011 IMPLAN data was collected, and 2) It was not considered realistic to report increasing tax revenue collections for a drought of record.

Table 3-2 Impacts of Water Shortages on Irrigation in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$30	$28	$25	$24	$22	$20
Job losses	647	610	547	506	464	427

***** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

3.3 Impacts for Livestock Water Shortages

None of the 7 counties in the region are projected to experience water shortages in the livestock water use category for one or more decades within the planning horizon. Estimated impacts to this water use category appear in Table 3-3. Note that tax impacts are not reported for this water use category for similar reasons that apply to the irrigated agriculture water use category described above.

Table 3-3 Impacts of Water Shortages on Livestock Sector in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	-	-	-	-	-	-
Jobs losses	-	-	-	-	-	-

***** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

3.4 Impacts for Municipal Water Shortages

One of the 7 counties in the region are projected to experience water shortages in the municipal water use category for one or more decades within the planning horizon. Impact estimates were made for the two subtypes of use within municipal use: residential, and non-residential. The latter includes commercial and institutional users. Consumer surplus measures were made for both residential and non-residential demands. In addition, available data for the non-residential, water-intensive portion of municipal demand allowed use of IMPLAN and TWDB Water Use Survey data to estimate income loss, jobs, and taxes. Trucking cost estimates, calculated for shortages exceeding 80 percent, assumed a fixed cost of $20,000 per acre-foot to transport water for municipal use. The estimated impacts to this water use category appear in Table 3-4.

Table 3-4 Impacts of Water Shortages on Municipal Water Users in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Income losses[1] ($ millions)*	$38	$69	$145	$231	$312	$391
Job losses[1]	762	1,367	2,888	4,585	6,193	7,770
Tax losses on production and imports[1] ($ millions)*	$4	$6	$14	$22	$29	$37
Consumer surplus losses ($ millions)*	$5	$14	$27	$46	$64	$87
Trucking costs ($ millions)*	-	-	-	$0	$0	$2
Utility revenue losses ($ millions)*	$10	$18	$26	$47	$61	$93
Utility tax revenue losses ($ millions)*	$0	$0	$0	$1	$1	$2

[1] Estimates apply to the water-intensive portion of non-residential municipal water use.
**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

3.5 Impacts of Manufacturing Water Shortages

Manufacturing water shortages in the region are projected to occur in 1 of the 7 counties in the region for at least one decade of the planning horizon. Estimated impacts to this water use category appear in Table 3-5.

Table 3-5 Impacts of Water Shortages on Manufacturing in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$1,515	$1,708	$1,894	$2,053	$2,306	$2,578
Job losses	9,965	11,236	12,464	13,509	15,173	16,964
Tax losses on production and Imports ($ millions)*	$82	$92	$102	$111	$125	$139

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

3.6 Impacts of Mining Water Shortages

Mining water shortages in the region are projected to occur in 4 of the 7 counties in the region for at least one decade of the planning horizon. Estimated impacts to this water use type appear in Table 3-6.

Table 3-6 Impacts of Water Shortages on Mining in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$2	$4	$4	$3	$3	$3
Job losses	34	72	77	58	43	40
Tax losses on production and Imports ($ millions)*	$1	$3	$3	$2	$1	$1

Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.

3.7 Impacts of Steam-Electric Water Shortages

Steam-electric water shortages in the region are projected to occur in 1 of the 7 counties in the region for at least one decade of the planning horizon. Estimated impacts to this water use category appear in Table 3-7.

Note that estimated economic impacts to steam-electric water users:

- Are reflected as an income loss proxy in the form of the estimated additional purchasing costs for power from the electrical grid that could not be generated due to a shortage;
- Do not include estimates of impacts on jobs. Because of the unique conditions of power generators during drought conditions and lack of relevant data, it was assumed that the industry would retain, perhaps relocating or repurposing, their existing staff in order to manage their ongoing operations through a severe drought.
- Does not presume a decline in tax collections. Associated tax collections, in fact, would likely increase under drought conditions since, historically, the demand for electricity increases during times of drought, thereby increasing taxes collected on the additional sales of power.

Table 3-7 Impacts of Water Shortages on Steam-Electric Power in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Income Losses ($ millions)*	$89	$142	$213	$299	$378	$472

Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by

a zero ($0) indicate income losses less than $500,000.

3.8 Regional Social Impacts

Projected changes in population, based upon several factors (household size, population, and job loss estimates), as well as the accompanying change in school enrollment, were also estimated and are summarized in Table 3-8.

Table 3-8 Region-wide Social Impacts of Water Shortages in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Consumer surplus losses ($ millions)*	$5	$14	$27	$46	$64	$87
Population losses	2,095	2,439	2,934	3,426	4,016	4,627
School enrollment losses	388	451	543	634	743	856

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

Appendix A - County Level Summary of Estimated Economic Impacts for Region E

County level summary of estimated economic impacts of not meeting identified water needs by water use category and decade (in 2013 dollars, rounded). Values presented only for counties with projected economic impacts for at least one decade.

**** Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000***

		Income losses (Million $)*						Job losses						Consumer Surplus (Million $)*					
County	Water Use Category	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
CULBERSON	MINING	$1	$3	$3	$2	$2	$1	13	47	54	41	29	19	-	-	-	-	-	-
CULBERSON Total		**$1**	**$3**	**$3**	**$2**	**$2**	**$1**	**13**	**47**	**54**	**41**	**29**	**19**	**-**	**-**	**-**	**-**	**-**	**-**
EL PASO	IRRIGATION	$8	$7	$5	$4	$3	$3	191	172	127	103	86	74	-	-	-	-	-	-
EL PASO	MANUFACTURING	$1,515	$1,708	$1,894	$2,053	$2,306	$2,578	9,965	11,236	12,464	13,509	15,173	16,964	-	-	-	-	-	-
EL PASO	MINING	-	-	-	-	$0	$2	-	-	-	-	3	14	-	-	-	-	-	-
EL PASO	MUNICIPAL	$38	$69	$145	$231	$312	$391	762	1,367	2,888	4,585	6,193	7,770	$5	$14	$27	$46	$64	$87
EL PASO	STEAM- ELECTRIC POWER	$89	$142	$213	$299	$378	$472	-	-	-	-	-	-	-	-	-	-	-	-
EL PASO Total		**$1,650**	**$1,926**	**$2,258**	**$2,587**	**$3,000**	**$3,447**	**10,918**	**12,774**	**15,479**	**18,197**	**21,454**	**24,823**	$5	$14	$27	$46	$64	$87
HUDSPETH	IRRIGATION	$22	$21	$20	$20	$18	$17	456	438	421	404	378	353	-	-	-	-	-	-
HUDSPETH Total		**$22**	**$21**	**$20**	**$20**	**$18**	**$17**	**456**	**438**	**421**	**404**	**378**	**353**	-	-	-	-	-	-
TERRELL	MINING	$1	$1	$1	$1	$1	$0	21	25	24	17	12	6	-	-	-	-	-	-
TERRELL Total		**$1**	**$1**	**$1**	**$1**	**$1**	**$0**	**21**	**25**	**24**	**17**	**12**	**6**	-	-	-	-	-	-
Grand Total		**$1,674**	**$1,951**	**$2,283**	**$2,610**	**$3,020**	**$3,465**	**11,408**	**13,285**	**15,978**	**18,659**	**21,873**	**25,201**	**$5**	**$14**	**$27**	**$46**	**$64**	**$87**

CHAPTER 7

REGIONAL DROUGHT RESPONSE

This page intentionally left blank.

7 REGIONAL DROUGHT RESPONSE

Drought is a frequent and inevitable factor in the climate of Texas. 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 Texas Water Development Board published "Drought Management in the Texas Regional and State Water Planning Process" (http://www.twdb.texas.gov/publications/reports/contracted_reports/doc/0804830819_DroughtMgmt.pdf) 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 Texas Administrative Code (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 significant drought impacts within the Region.

7.1 DROUGHT OVERVIEW

The severity of the current drought has significantly impacted the lives of water users, providers and water managers who have been hard-pressed to find solutions to critical supply and demand issues. The severity of the impacts varies, but the overriding sense of urgency to create workable strategies and solutions has been acknowledged and acted upon Statewide. Therefore, it is critical in this planning cycle to address the impact that drought is currently having and will have on the future use, allocation and conservation of water in Far West Texas.

There are different types of drought that have been defined in various ways; however, these definitions fall into four primary categories: meteorological, agricultural, hydrological and socioeconomic drought. In the most general sense, drought is a deficiency of precipitation over an extended period of time, resulting in a water shortage for some activity, group or environmental purpose. The State Drought Preparedness Plan provides more specific and detailed definitions and is located at the following link:

http://www.txdps.state.tx.us/dem/CouncilsCommittees/droughtCouncil/droughtPrepPlan.pdf.

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.

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.

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.

Socioeconomic drought occurs when the demand for an economic product (such as hydroelectric power) exceeds supply due to a weather-related deficit. Typically, demand for a good increases with population growth and per capita consumptions. 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 is the key. However, when demand exceeds supply, vulnerability is magnified by water shortages during drought.

Several climatological drought indicators have been formulated in order 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 is a soil moisture index that works best in relatively large regions with uniform topography that don't experience extreme climate shifts. PDSI values can lag oncoming drought by several months. The TWDB uses the PDSI to monitor State drought conditions, which has values ranging between -6.0 (driest) to 6.0 (wettest). "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 Texas is included as Figure 7-1. The week of October 4, 2011 has the largest area of the State experiencing extreme drought (88 percent) for the period of record shown (January 2000 through August 2014). Texas did not experience drought conditions from October 2004 through February 2005.

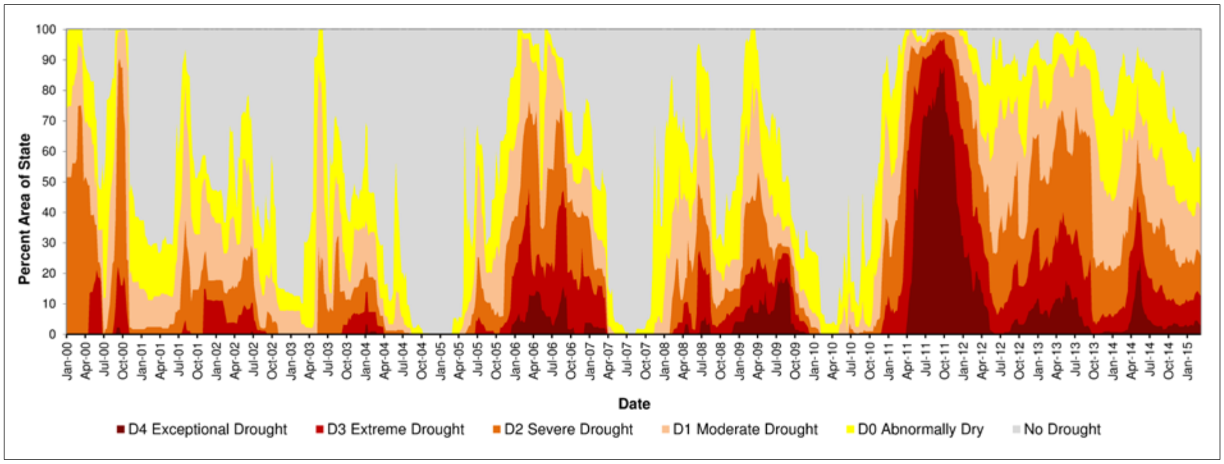


Figure 7-1. Drought in Texas, 2000-2014
Source: U.S. Drought Monitor

The Texas A&M Forest Service conducted a survey in 2012 in an attempt to estimate the number of trees lost in Texas after the 2011 drought. The survey considered rural forested area only and did not include trees lost in urban areas. The study split the State into ten regions: Panhandle, Trans-Pecos, North, Central, South, Brazos Valley, plus four regions in East Texas (Figure 7-2). The study results indicate that 301 million trees died, with the greatest loss occurring in the Brazos Valley Region, which lost nearly ten percent of trees located on forest land. The Trans-Pecos Region, which envelops the Far West Texas Region, lost 7.5 percent of its trees, constituting the fourth largest tree mortality rate in the State.

Region	Live trees prior to the drought (million trees)	Drought-related mortality (million trees)	Drought-related mortality (percentage)
Southeast - East	597.1	7.5	1.3
Southeast - West	289.7	18.8	6.5
Northeast - East	356.0	13.9	3.9
Northeast - West	309.4	25.3	8.2
North	370.5	30.9	8.3
Brazos Valley	256.4	24.9	9.7
South	431.2	31.7	7.4
Central	1,540.0	102.3	6.6
Panhandle	556.3	33.1	6.0
Trans-Pecos	163.4	12.2	7.5
Total	4,869.9	300.6	6.2

Figure 7-2. Texas Tree Mortality Counts in 2012
Source: Texas A&M Forest Service Survey

The history of drought in Texas can be demonstrated through the observation of tree rings. A recent study by Cleveland and others (2011) used tree ring data from species such as Douglas Fir, Bald Cypress and Post Oaks located in the Trans-Pecos, the Edwards Plateau and South Central Texas. These data suggest that extended droughts (lasting more than a decade) have occurred in Texas at least once a century since the 1500s (Figure 7-3). The study (using the PDSI) ranked the current Drought of Record (DOR) from 1951 to 1965 as the driest drought since 1500 in the Trans-Pecos Region. A drought that occurred from 1575 to 1585 is ranked as the second driest, and a drought from 1662 to 1676 is ranked as the third driest in the Trans-Pecos. This study was published in 2011 and does not consider the current drought.

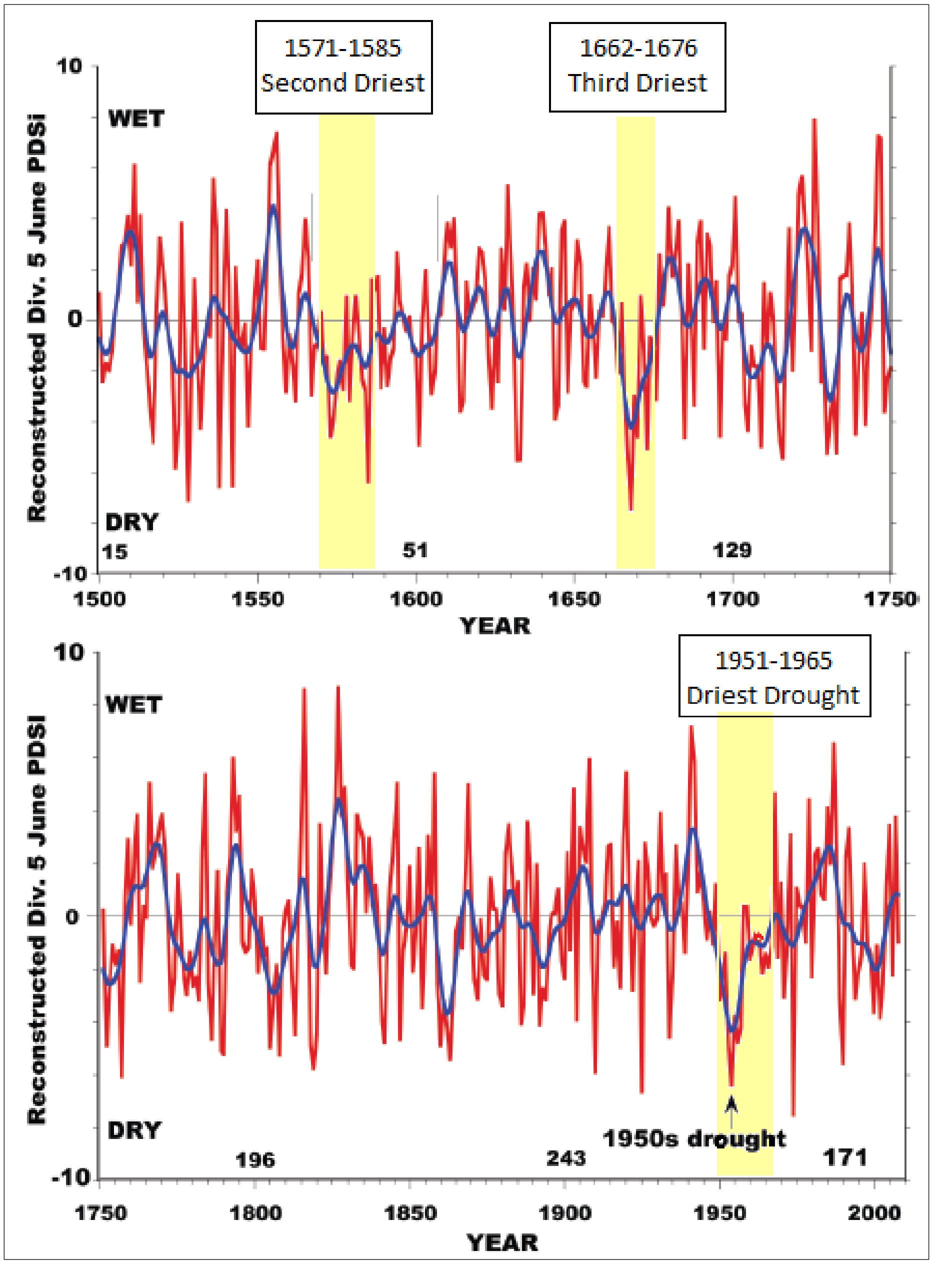


Figure 7-3. Reconstructed PDSI for Trans-Pecos and Tree Ring Data, Cleveland and Others in the Texas Water Journal, Vol.2: 54-96

7.2 DROUGHTS IN FAR WEST TEXAS

Far West Texas, including the Trans-Pecos Regions is perennially under drought or near drought conditions compared with more humid areas of the State. Citizens of the Region experience a wide range of weather conditions due to the Region being located in the middle latitudes and northwest of the Gulf of Mexico. Although residents of the Region are generally accustomed to these conditions, the 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.

The climate of Far West Texas is comprised of two main elements: temperature and precipitation. The greatest stress placed on water availability typically occurs during the warmest months of the year (June, July, and August). Warmer temperatures result in greater water loss by evaporation and transpiration.

Figure 7-4 presents the average total precipitation by month across the Trans Pecos Region (which includes Far West Texas) using data from the National Climatic Data Center for the period of 1895 to 2012. Zero precipitation has occurred at least once during the months of: January, February, March, April, November and December. Peak precipitation occurs in September.

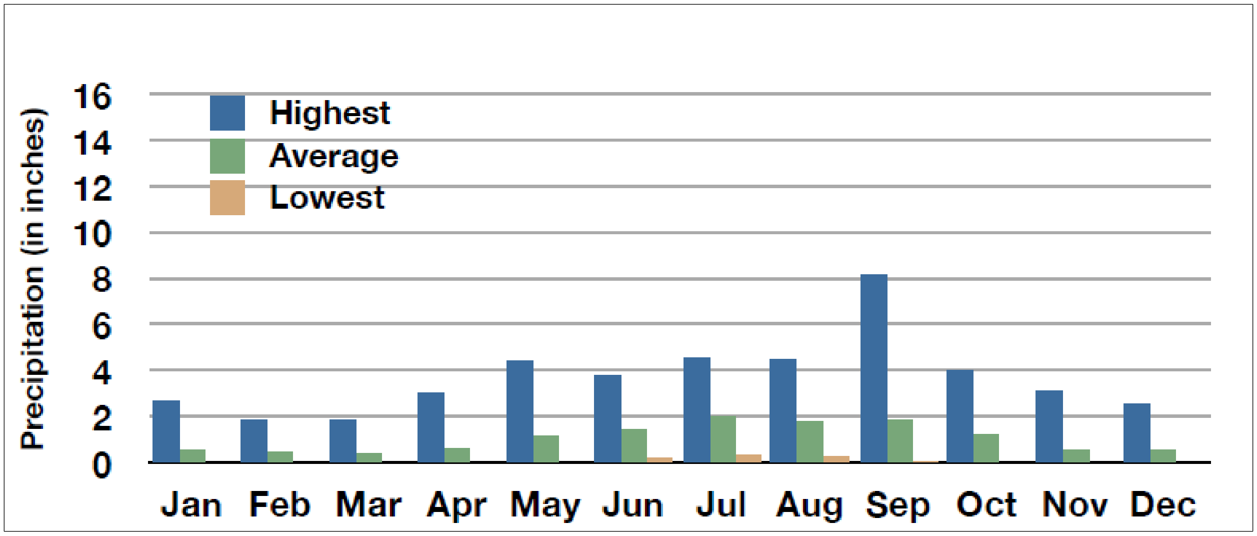


Figure 7-4. Total Precipitation by Month for the Trans-Pecos Region
Source: NCDC

Figure 7-5 presents the Palmer Drought Severity Index for the Region from 1895 to 2012. Red boxes outline the drier-than-average periods. It is evident that the Far West Texas Region has experienced long and extreme droughts in the past. Departure from normal precipitation (actual precipitation total for the year subtracted from the annual normal) is displayed in Figure 7-6. These data were derived by using the Palmer Drought Severity Index and two-year Standardized Precipitation Index for the Trans Pecos Region from 1895 to 2012.

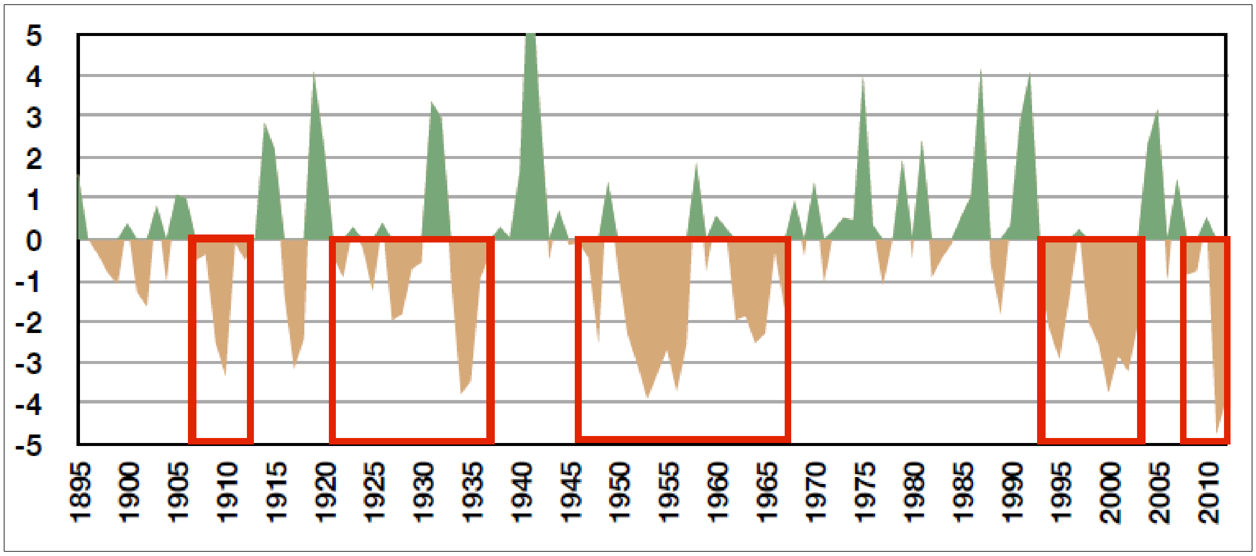


Figure 7-5. Palmer Drought Severity Index for the Trans-Pecos Region
Source: NCDC

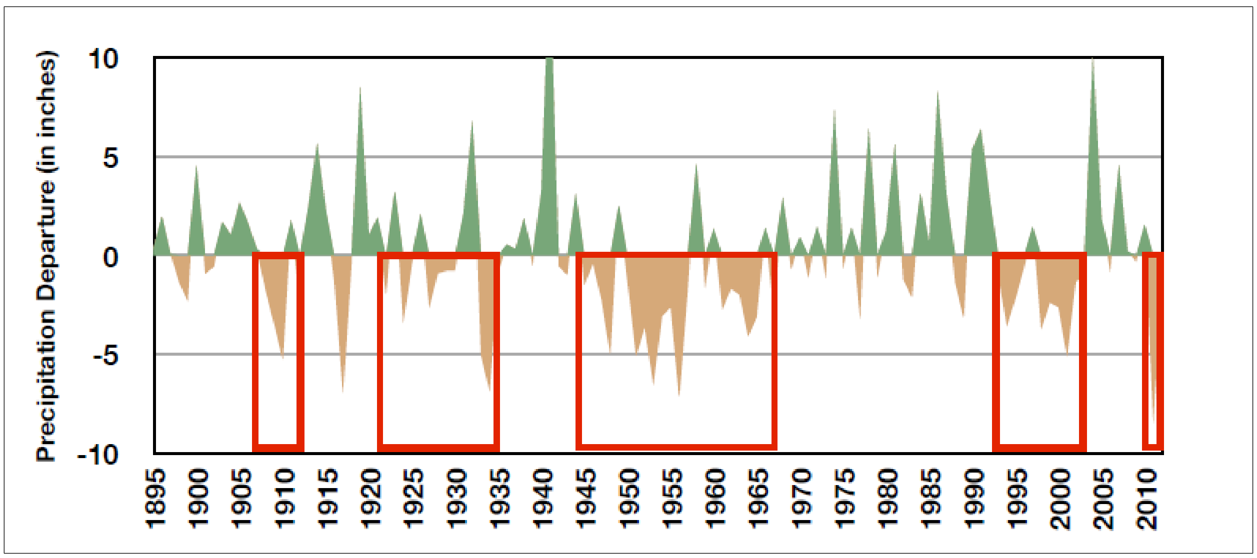


Figure 7-6. Annual Departure from Normal Precipitation for the Trans-Pecos Region
Source: NCDC

Comparing the 1950s DOR and the current drought can be accomplished using historic precipitation, stream flow records, spring discharge, and water level measurements in wells for locations that have accumulated data measurements since the 1940s.

7.2.1 Precipitation Indicator

Average annual precipitation varies from about 8 inches a year in El Paso County to nearly 15 inches in Jeff Davis County, based on NWS cooperator weather station data. Due to low precipitation across the Region, population growth thus results in an ever increasing reliance on conservation and innovative water management strategies. Figure 7-7 shows annual precipitation from 1940 through 2012 and ten-year census population data.

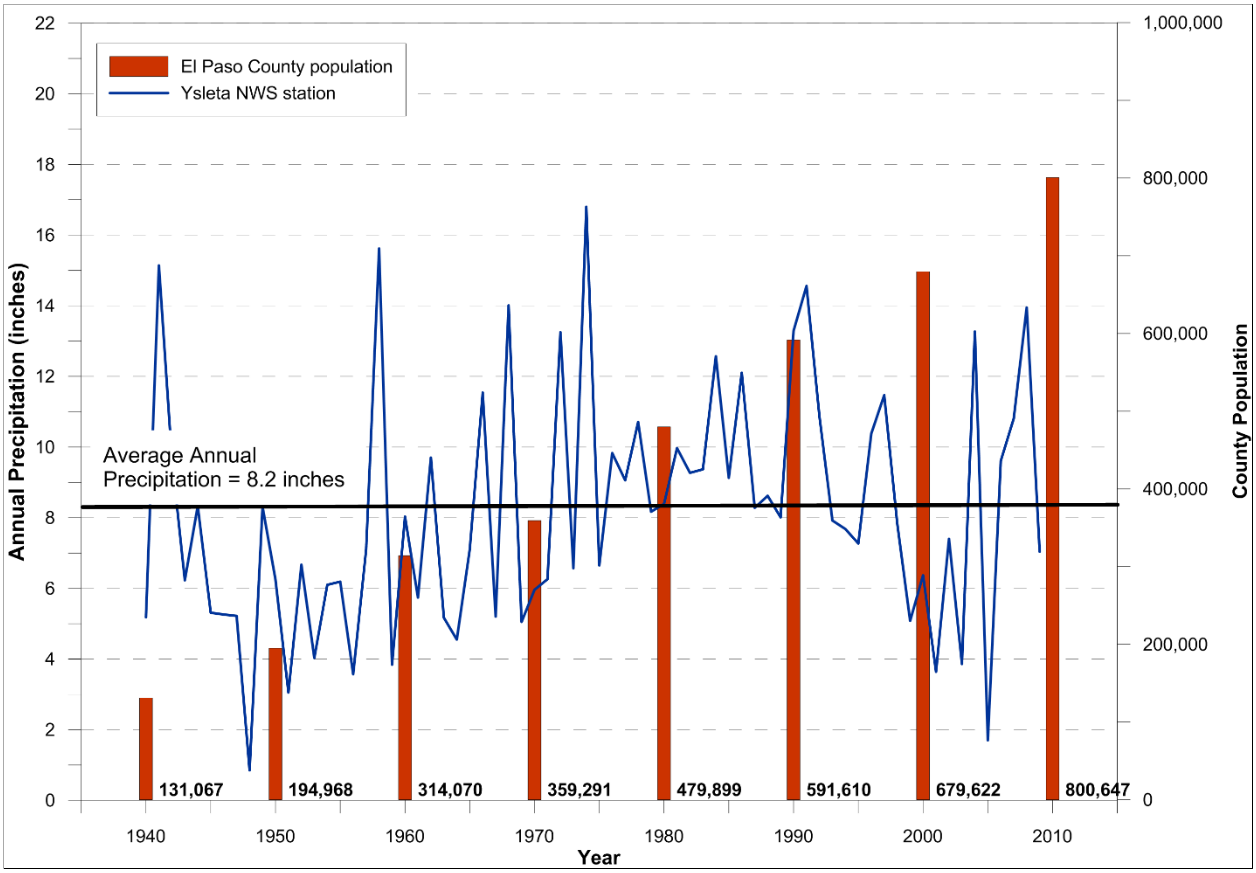


Figure 7-7. Annual Rainfall vs Population, El Paso County, 1940-2012
Source: NWS, US Census

The greatest precipitation impact to the Region comes further north in New Mexico and southern Colorado. Along the Rio Grande lies New Mexico’s largest reservoir, Elephant Butte Reservoir. In terms of Far West Texas’ surface water availability, it is the annual volume of water released from the Elephant Butte that must try to meet a portion of the growing water demands of the Region. However, severe drought has driven the storage levels of the Elephant Butte Reservoir to record lows, currently less than ten percent full, or 97 feet into the reservoirs “dead pool’. This is one of the many problems in a series of drought-related challenges facing the Region.

Figure 7-8 presents the storage capacity of Elephant Butte Reservoir from 1915 through 2014. The graph illustrates that the most significant declines in capacity due to drought impacting the reservoir occurred between 1945 and 1957 and between 2000 and 2005. The longest sustained period of very low capacity occurred between 1954 and 1957.

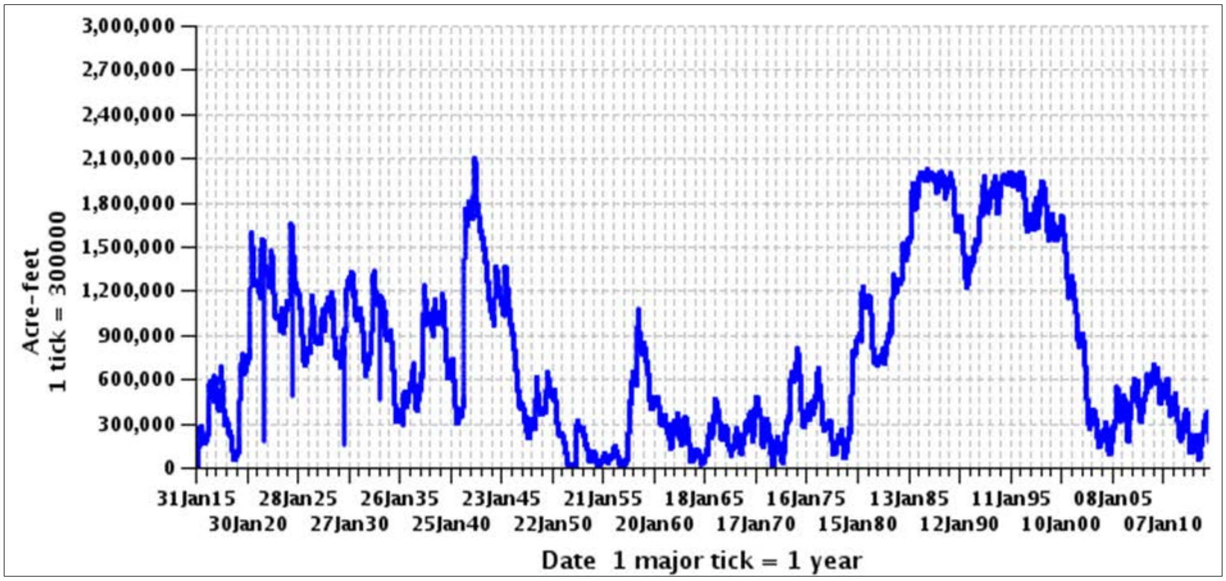


Figure 7-8. Storage Levels for Elephant Butte Reservoir 1915-2014
Source: U.S. Department of the Interior Bureau of Reclamation

Although water users located near the Rio Grande are more significantly impacted by precipitation that falls within the upper reaches of the Rio Grande Basin in New Mexico and southern Colorado, this is not the case for water users who are located further from the river. Precipitation in these areas provides important recharge to aquifers that are annually diminished by pumping withdrawals.

7.2.2 Stream Flow Indicator

The monitoring of streamflow of a river can generally provide a reliable indication of drought conditions throughout much of the State. However, gaging streamflow of the Rio Grande must be performed with knowledge of other factors that impact the supply of water in the river. Depending on the location of the stream gage, releases from Elephant Butte Reservoir and reservoirs on the Rio Conchos in Mexico have a large influence on streamflow at any given time.

A graph of streamflow at IBWC gaging station 08-374200.00 located on the Rio Grande just below the confluence with the Rio Conchos is included as Figure 7-9. The top graph illustrates peak events; the bottom graph focuses on low flow/no flow events. The construction and filling of Elephant Butte Reservoir accounts for the data gap between 1914 and 1930. The Luis L. Leon Reservoir (on the Rio Conchos) was completed in 1968.

Peak flows since 1900 have decreased after the construction of Elephant Butte Reservoir. The most current extreme peak occurred in 2008. The late spring and summer of 2008 was an abnormally wet season from the monsoonal rainfall over Mexico and southwest Texas (Hurricane Dolly in July, followed by tropical storm Julio in late August followed by tropical storm Lowell in September). The peak flow of 51,206 cfs occurred on September 19, 2008. Levees failed at Presidio, Texas and Ojinaga, Mexico causing extensive, devastating flooding in the area. The levees were designed for 42,000 cfs. Low-flow events appear to have occurred with relatively high frequency between 1900 and 1904, between 1952 and 1958, between 1996 and 2006. No flow was recorded between December 2011 and October 2014.

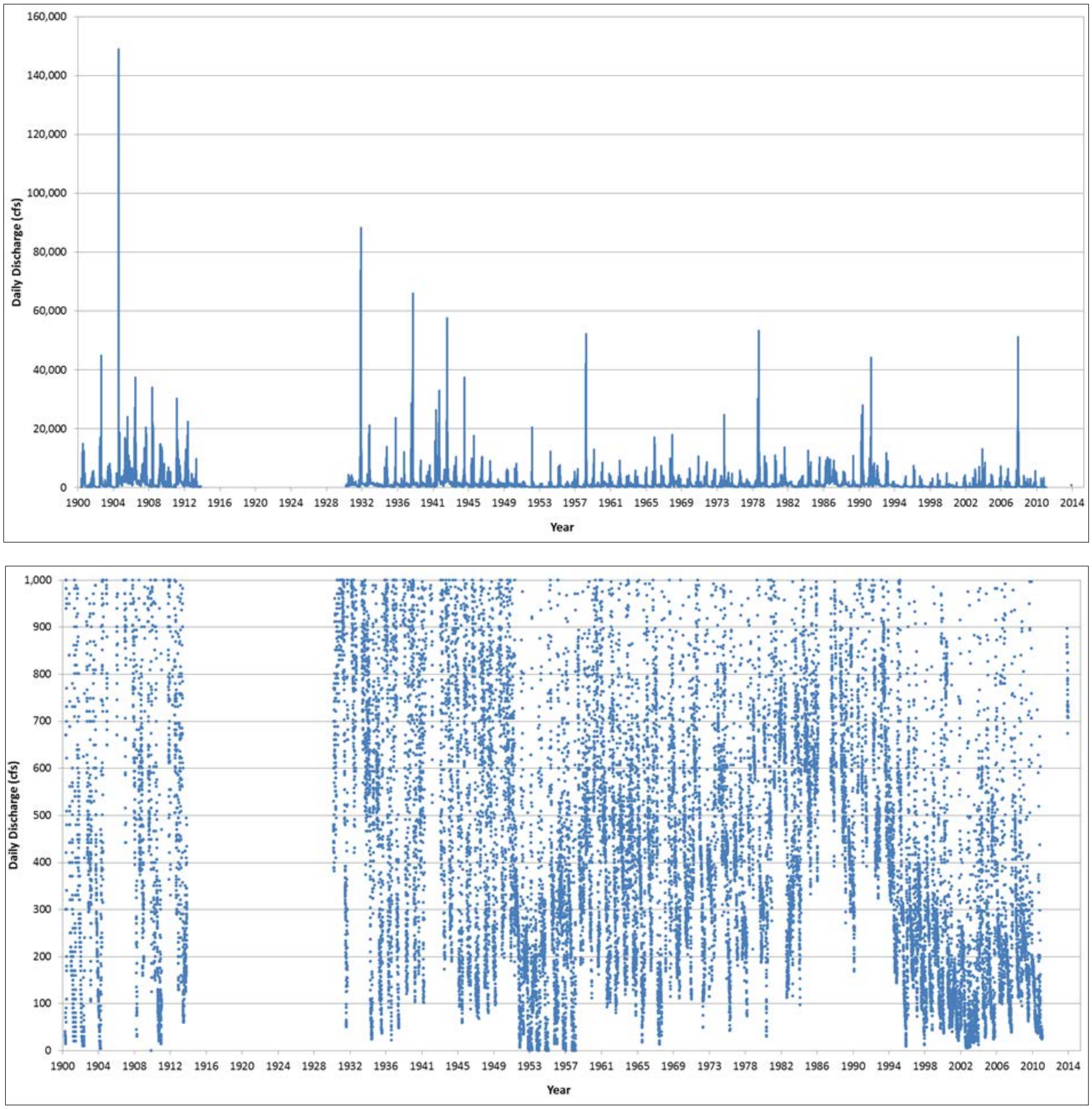


Figure 7-9. Streamflow below Rio Conchos Confluence 1900-2014
Source: IBWC

7.2.3 Spring Discharge Indicator

The San Solomon Spring System includes several springs that discharge to the ToyahvilleBasin near Toyahville, Texas. This group of springs includes: Phantom Lake, San Solomon, Giffin, Saragosa, West and East Sandia springs.

The only spring in this system that has a gaging station with a continuous period of record from the 1940s through today is Giffin Springs (Figure 7-10). The period of record actually extends back to 1930; however, measurements were sporadic prior to 1941. The average discharge for all measurements between 1931 and 2014 is 4.4 cfs. The graph indicates that the longest period of below average flow within this period of record occurred between 1964 and 1981. Note that most of these years had between two and four discharge measurements recorded.

Some of the springs within this system have ceased to flow. For example, Phantom Lake Springs in Jeff Davis County are the highest in elevation of all of the springs in the San Solomon Spring System. This spring stopped flowing in 2001 and since that time, has only flowed intermittently between 2004 and 2010. This is partially attributed to irrigation pumping in the local area.

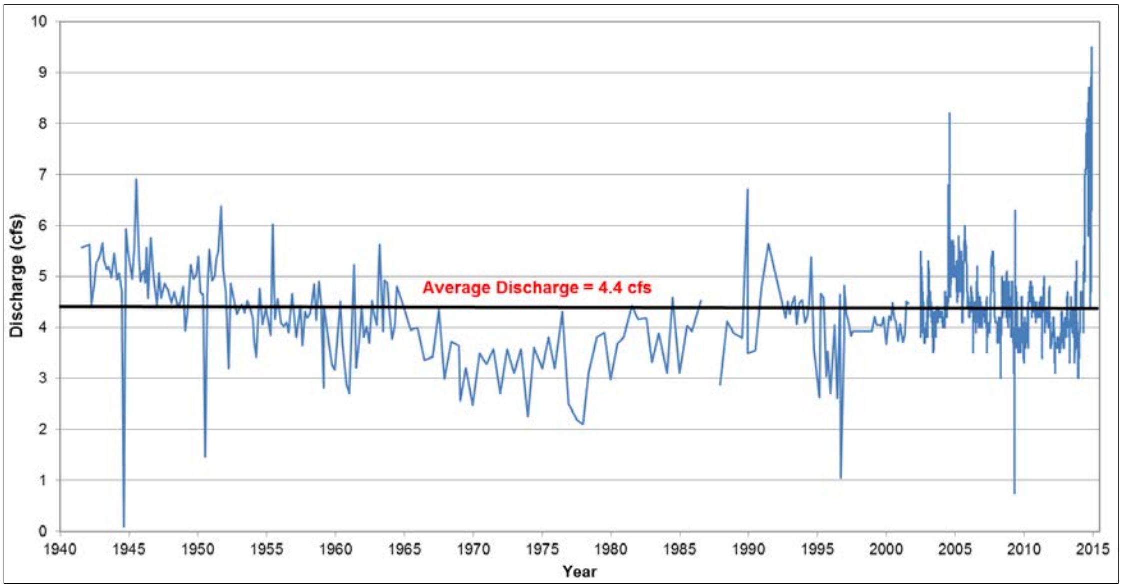


Figure 7-10. Giffin Springs Discharge 1941-2014

7.2.4 Groundwater Level Indicator

Figure 7-11 compares daily water level data from an existing real-time monitoring well with daily precipitation data from nearby NWS Cooperative Weather Station to illustrate aquifer response to precipitation events. This graph represents state well 73-47-404 which is completed within the Jeff Davis Volcanics Aquifer in Brewster County. The data suggests that response time in the aquifer is quite rapid and occurs within a few days. Not all wells can be so readily correlated to rainfall events. Out of the nine pairs of wells and weather stations that were investigated within the Region, only this well showed an obvious response to rainfall occurring near the well.

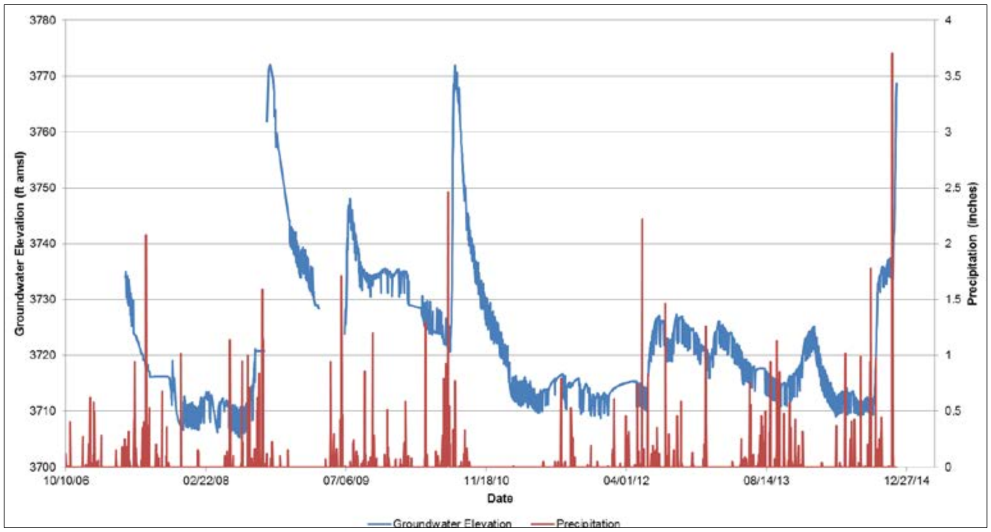


Figure 7-11. Daily Groundwater Elevation and Daily Precipitation, Volcanics Aquifer, Brewster County

7.2.5 Far West Texas Region Drought of Record

The South Central Climate Science Center prepared a report on the drought history for the Trans-Pecos of Texas in May of 2013. In this report, they determined that the period from February 1943 to November 1967 is the Drought of Record (DOR) for the Texas Trans-Pecos. The study points out that they consider the drought with the worst environmental conditions to outweigh the drought with the worst recorded impacts. They stated that a shorter less severe drought with high monetary losses (such as in 2011) does not outweigh a long and severe drought that occurred earlier in history. The study looked at data between 1895 and 2013.

For the purpose of this planning cycle, the drought of the 1950s is declared the DOR. It is impossible to state whether the current drought ultimately will become the new DOR because we do not know how many years the current drought will last. The DOR in the 1950s lasted for many years so it may be a while before that distinction can be made.

The catalyst for the current drought can be attributed primarily to rainfall deficit (meteorological drought). The hydrological drought that has occurred as a result of rainfall deficit is evident in the decreased storage water levels of the Elephant Butte Reservoir, along with the decrease in the 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 demand exceeds supply due to a weather-related deficit. Typically, demand for a product increases with population growth and per capita consumptions. 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 is the key. However, when demand exceeds supply, vulnerability is magnified by water shortages during drought.

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 drought contingency plans that have been adopted by municipalities and Groundwater Conservation Districts within the Far West Texas Region. The summary includes what specific triggers are used to determine the onset of each defined drought stage and the associated response actions that have been developed by local entities to decrease water demand during the particular 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 drought contingency plans (DCPs). In addition, many Groundwater Conservation Districts also have DCPs that provide education and voluntary action recommendations.

Plans are required to be made available for inspection upon request. Guidelines as to what should be included in each drought contingency plan can be found on TCEQ's website at the following link: http://www.tceq.texas.gov/permitting/water_rights/contingency.html/#contents

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 drought contingency plans 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.

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. The annual allotment of Rio Grande Project water is determined by the U.S. Bureau of Reclamation (USBR) based on the amount of usable water in storage in Elephant Butte and Caballo Reservoirs. Based on the amount of storage remaining in Elephant Butte and Caballo Reservoirs at the end of the primary irrigation season (early- to mid-October), the USBR determines the amount of water that will be delivered the following year. In general, a one-year drought in the Upper Rio Grande drainage basin will have little effect on overall storage in the reservoirs. However, a long-term drought would have a significant effect on water releases downstream. Downstream users, both irrigation and municipal, are thus aware in advance of coming surface water supply shortages and can react accordingly.

The City of El Paso's Drought and Emergency Management Plan (2014) is administered through EPWU and is based on three Drought or Water Emergency Stages: (1) At Stage I El Paso County Water Improvement District No. 1 (EPCWID#1) declares surface water allotment is less than 0.5 acre-feet per acre on or before April 1st; or when water demand is projected to exceed available capacity as determined by El Paso Water Utilities; (2) A Stage II water emergency is triggered when the EPCWID#1 declares surface water allotment of less than 1.0 acre-feet per acre after April 1 but before May 1st or there is not enough continuous release of surface water; or water demand is projected by EPWU to exceed available capacity; (3) A Stage III water emergency is triggered when the EPCWID#1 declares surface water allotment of less than 1.5 acre-feet per acre after May 1 but before May 15th or there is not enough continuous release of surface water; or water demand is projected by EPWU to exceed available capacity. A water emergency may also be declared based on a water system failure due to weather, electrical or mechanical failure or contamination of source. Once any stage is declared, the General Manager of the EPWU can implement a variety of response measures designed to conserve water. These range from use restrictions to citations for noncompliance.

Most of the other communities in El Paso County receive their water supplies from EPWU or from other water-supply entities including the Horizon Regional MUD, El Paso County WCID No.4, and the Lower Valley Water District. Because of their reliance on supply provided by EPWU, the Lower Valley Water District drought contingency triggers and responses are similar to the triggers and responses developed by EPWU. The other wholesale water providers rely on groundwater, which is discussed under the following Groundwater Triggers section.

Irrigation districts depend on runoff from watersheds in the Upper Rio Grande drainage basins of New Mexico and southern Colorado to provide surface water to support irrigation in El Paso and Hudspeth Counties. Hence, drought triggers for the El Paso County Water Improvement District No.1 (EPCWID #1) and the Hudspeth County Conservation and Reclamation District No.1 (HCCRD #1) are established based on storage levels in Elephant Butte and Caballo Reservoirs, which are in turn dependent on meteorological and hydrological conditions in these watersheds.

Drought conditions, which impact the EPCWID #1, are those that affect the headwaters of the Rio Grande and its tributaries, such that Rio Grande Compact water deliveries into Elephant Butte Reservoir are reduced. The district's board of directors determines when a drought exists and establishes the yearly delivery allotment to its water users based on its diversion allocation from the USBR. Generally, when water storage in Elephant Butte Reservoir is less than 0.9 million acre-ft during the irrigation season (March through September), the USBR declares drought conditions and sets its diversion allocations (using the D1 and D2 curves) to the irrigation districts based on a delivery allotment of less than its normal (non-drought) 3 acre-foot per acre. During times of drought, the district will lower its delivery allotment based on the amount of its reduced diversion allocation from the USBR and its delivery commitments to its users. The extent of the reductions in the water allotments will be dependent on the severity of the drought conditions, and will remain in effect until the conditions that triggered the drought contingency no longer exist.

The HCCRD #1 bases drought contingency planning on evaluation of the water supply projected and received by the EPCWID #1, since all waters received by HCCRD #1 are return flows and operational spills for El Paso County. Since conditions, to a degree, can be predicted prior to a crop season, the drought mitigation plan largely affects agricultural producers cropping plan. When a mild or moderate predicted shortage occurs, the HCCRD #1 will notify its clientele of the amount of the expected shortage. For a severe shortage, where the water supply will provide less than 50 percent of the expected demand, agricultural producers will be asked to prioritize their water requests based upon crop needs.

Water in the Lower Rio Grande segment is used principally for irrigation, recreation, and environmental needs. A drought trigger for this segment of the river is based on flows of less than 35,438 acre-feet. The TCEQ Rio Grande Watermaster administers the allocation of Texas' share of the international water and is responsible for informing water-rights users of expected diversions during drought years.

7.3.3 Groundwater Triggers

Groundwater triggers that indicate the onset of drought in Far West Texas are not as easily identifiable as relative to surface-water triggers. 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.

Several groundwater basins are identified in Chapter 3 as aquifers that will likely not experience consistent water-level decline, or mining, based on comparisons between projected demand, recharge and storage. In these areas, water levels might be expected to remain constant or relatively constant over the 2020 to 2070 planning period. Because of minimal water-level changes in these aquifers, water levels are not recommended as a drought-condition trigger. Atmospheric conditions are a better indicator for these areas.

Basins that do not receive sufficient recharge to offset natural discharge and pumpage may be depleted of groundwater (e.g., mined). The rate and extent of groundwater mining 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 uneconomic. 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 during drought as a sufficient indicator.

Water levels in observation wells in and adjacent to municipal well fields, especially where wells are completed in aquifers that respond relatively quickly to recharge events, may be established as drought triggers for municipalities in the future providing a sufficient number of measurements are made annually to establish a historical record. Water levels below specified elevations for a pre-determined period of time might be interpreted to be reasonable groundwater indicators of drought conditions. Until such historical water-level trends are established, municipalities will likely continue to depend on demand as a percentage of production capacity as their primary drought trigger. Twelve water-supply entities were listed in Table 6-1 in the 2011 Plan. All of the entities drought triggers are structured around system production capacity and daily demand, except for El Paso, which is structured upon surface-water allotment stages. None of the entities used groundwater triggers. However while most of the entities rely on a system capacity trigger of some kind, they also have groundwater wells that they pump from and monitor.

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 Far West Texas Region that rely on groundwater generally establish drought-condition triggers based on levels of demand that exceed a percentage of the systems production capacity. Alpine, Van Horn (and Sierra Blanca) Anthony, Vinton, Horizon Regional MUD (Horizon City), Dell City, Fort Davis WSC (Fort Davis), Marfa, Presidio and Terrell County WCID #1 (Sanderson) have adopted system capacity triggers. Several entities have drought responses triggered when daily water demand exceeds 75 percent of production capacity.

El Paso (EPWU) receives surface water allocations from the local irrigation district, El Paso County Water Improvement District No.1 (EPCWID#1) via the Rio Grande Project. Currently, El Paso has water rights to about 70,000 ac-ft/yr. EPWU initiates the various drought triggers based on the amount of surface water being provided by the EPCWID #1 as described in Section 7.3.2 above.

7.3.5 Municipal and Wholesale Water Provider Drought Contingency Plans

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 as a way 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 at:

http:// www.tceq.state.tx.us/permitting/water_supply/water_rights/contingency.html.

Drought contingency plans 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 drought contingency plans which are assessable at the specified websites:

- City of Alpine (http://cityofalpine.com/)
- City of Van Horn (http://vanhornutilities.com)
- Town of Anthony (http://townofanthony.org/index.php)
- City of El Paso (EPWU) (http://home.elpasotexas.gov/)
- El Paso County Tornillo WID
- El Paso County WCID #4 (Fabens)
- Fort Bliss

- Horizon Regional MUD (http://horizonregional.com/)
- Lower Valley Water District (http://www.lvwd.org/)
- City of Clint (drought plan same as LVWD)
- City of San Elizario (drought plan same as LVWD)
- City of Socorro (drought plan same as LVWD)
- City of Vinton (drought plan same as EPWU)
- Fort Davis WSC
- City of Marfa
- City of Presidio (http://presidiotx.us/)
- Terrell County WCID #1 (http://sandersonchamberofcommerce.info/services/tcwcid.htm)

A list of entities, their supply source, specific triggers and actions, for each drought stage is provided in Table 7-1.

Table 7-1. 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 Alpine	Igneous (Meriwea ther #1 & #2 wells)	Demand-based triggers include the following components: 1) percent of water treatment capacity, 2) total daily demand as percent of pumping capacity, 3) storage capcity and 4) well pump run time.	Demand reaches 90% of production capacity; system failure that would limit the capacity of the system below 85% during peak demand periods.	Demand reaches 95% of production capacity; system failure that would limit the capacity of the system below 75% during peak demand periods.	Demand reaches 100% of production capacity; system failure that would limit the capacity of the system below 70% during peak demand periods.	Extended period of severe condition or any natural catastrophic situation.	N/A
			Voluntary- reduce water demand.	Mandatory- lawn watering schedule.	Set limits on water consumption; prohibit use of specific outdoor watering activities.	N/A	N/A
City of Clint	Hueco-Mesilla Bolson	Purchase water from LVWD - see LVWD drought triggers and actions					
City of El Paso (EPWU)	Hueco-Mesilla Bolson	Surface water allotment from El Paso Co. WID #1; system capacity limits.	EPCWID decreases allotment less than 0.5 acre foot per acre on or before April 1; water demand is projected to exceed EPWU system capacity.	EPCWID decreases allotment less than 1.0 acre foot per acre on or after April 1 but before May 1 or there is not a continuous release of surface water; water demand is projected to exceed EPWU system capacity.	EPCWID decreases allotment less than 1.5 acre foot per acre after May 1 but before May 15 or there is not a continuous release of surface water; water demand is projected to exceed EPWU system capacity.	N/A	N/A
			Voluntary- reduce water demand by 25%.	Mandatory- lawn watering schedule.	Set limits on water consumption; prohibit use of specific outdoor watering activities.	N/A	N/A

Table 7-1. (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 Marfa	Igneous	Base on water supply and/or demand conditions.	Demand exceeds 90% of production capacity for 3 consecutive days; system disruption occurs that limits the capacity of the system below 85% during peak demand periods.	Demand exceeds 95% of production capacity for 3 consecutive days; system disruption occurs that limits the capacity of the system below 75% during peak demand periods.	Demand exceeds 98% of production capacity for 3 consecutive days; system disruption occurs that limits the capacity of the system below 70% during peak demand periods.	Extended period of severe condition or any natural catastrophic situation.	N/A
			Voluntary- reduce water demand by 1-5%.	Reduce water demand by 5-10%.	Reduce water demand by10-15%.	Reduce water demand by15-20%.	Reduce water usage as deemed necessary.
City of Presidio	West Texas Bolson	Base on system capacity limits.	Total daily water demand equals or exceeds 2 million gallons on a single day.	Total daily water demand equals or exceeds 2 million gallons for 3 consecutive days.	Total daily water demand equals or exceeds 2 million gallons for 7 consecutive days.	Total daily water demand equals or exceeds 2 million gallons for 14 consecutive days.	Major system failures or supply contamination.
			Voluntary- reduce water use below 2 million gallons per day.	Mandatory- reduce water use below 2 million gallons per day.	Mandatory- reduce water use below 2 million gallons per day by restricting non-essential water use.	Mandatory- reduce water use below 2 million gallons per day by restricting irrigation of landscaped areas.	Mandatory- reduce water use below 2 million gallons per day by allocating water according to the water allocation plan.
City of San Elizario	Hueco-Mesilla Bolson	Purchase water from LVWD - see LVWD drought triggers and actions					
City of Socorro	Hueco-Mesilla Bolson	Purchase water from LVWD - see LVWD drought triggers and actions					

Table 7-1. (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 Van Horn	West Texas Bolson	Demand exceeds production or storage capability measured over a 24 hr. period, and refilling the storage facilities is rendered impossible.	Triggers were not provided in the DCP	Triggers were not provided in the DCP	Triggers were not provided in the DCP	Demand exceeds 80% of production capacity.	Demand exceeds 90% of production capacity.
			Voluntary-reduce water use.	Limit water usage determined by the plant's capability to provide continuous service in direct proportion to the loss of production/refill capability of the storage facility.	All outdoor water usage is prohibited.	Allocate water.	All uses of public water supply will be banned except in cases of emergency.
City of Vinton	Hueco-Mesilla Bolson	Purchase water from EPWU - see EPWU drought triggers and actions					
El Paso County Tornillo WID	Hueco-Mesilla Bolson	Base on system capacity limits and known water levels in the groundwater well(s).	N/A	Treated water reservoir levels do not fill above 70% overnight.	Treated water reservoir levels do not fill above 50% overnight and/or static water level in the EPCTWID well is less than previous month.	EPCTWID well capacity is equal to or less than 80% of the well's original specific capacity.	Major system failures or supply contamination.
			Voluntary-reduce water demand by 3%.	Reduce water demand by 10%.	Reduce water demand by 30%.	Reduce water demand by 40%.	Reduce water demand by 50%.
El Paso County WCID #4	Hueco-Mesilla Bolson	Base on system capacity limits.	Average daily water use reaches 80% for 3 consecutive days.	Average daily water use reaches 90% for 3 consecutive days.	Average daily water use reaches 100% for 3 consecutive days.	Failure of system components is reduced to only one well.	Major system failures or supply contamination.
			Voluntary-reduce water demand by 15%.	Reduce water demand by 25%.	Reduce water demand by 50%.	Reduce water demand by 75%.	Reduce water demand by 75%.

Table 7-1. (Continued) Municipal Mandated Drought Triggers and Actions

Water Supply Entity	Water Supply Source	Drought Trigger	Drought Stage and Response				
			Mild	Moderate	Severe	Critical	Emergency
Fort Bliss	Hueco-Mesilla Bolson	Base on system capacity limits.	N/A	Demand exceeds 90% of production capacity for 2 consecutive days.	Demand exceeds 95% of production capacity for 2 consecutive days.	Demand exceeds 100% of production capacity for 2 consecutive days.	Major system failures or supply contamination.
			N/A	Reduce water demand by 20%.	Reduce water demand by 30%.	Reduce water demand by 40%.	Reduce water demand by 50%.
Fort Davis WSC	Igenous	Base on system capacity limits.	N/A	Total daily water demand ranges from 60-70% of production capacity.	Total daily water demand exceeds 75% of production capacity.	Total daily water demand exceeds 75% of production capacity for more than 5 consecutive days.	Major system failures or supply contamination.
			N/A	Reduce water demand by 60% for 3 consecutive days.	Reduce water demand by 75% for 4 consecutive days.	Reduce water demand by 75% for 4 consecutive days.	Reduce water demand by less than 75% for 3 consecutive days.
Horizon Regional MUD	Hueco-Mesilla Bolson	Base on system capacity limits and water levels in District's well(s).	Total daily water demands reach 80% of the District's capacity for 5 consecutive days.	Total daily water demands reach 90% of the District's capacity for 5 consecutive days.	Demand equals or exceeds 95% of the District's capacity for 3 consecutive days.	Demand meets 100% of capacity for 3 consecutive days.	Major system failures or supply contamination.
			Voluntary- reduce water demand by 10%.	Mandatory- reduce water demand by 10%.	Reduce water usage to a point the District can revert to the previous stage and continue to reduce usage until 10% reduction is secured.	Discontinue all non-essential and landscape irrigation water use.	Water rationing may be put into effect.
Hudspeth County WCID #1 (Sierra Blanca)	West Texas Bolson	No DCP Provided					

Table 7-1. (Continued) Municipal Mandated Drought Triggers and Actions

Water Supply Entity	Water Supply Source	Drought Trigger	Drought Stage and Response				
			Mild	**Moderate**	**Severe**	**Critical**	**Emergency**
Lower Valley Water District	Hueco-Mesilla Bolson	Water levels in Elephant Butte Reservoir are less than a designated depth; decrease in surface water allotment; and increase in demand.	Water stored in Elephant Butte Reservoir is less than 50,000 acre-feet; surface water allotment is less than or equal to 3.0 acre-ft./acre; or demand exceeds 90% system capacity.	Surface water allotment less than or equal to 2.5 acre-ft./acre; or demand exceeds 95% system capacity.	Surface water allotment less than or equal to 2.0 acre-ft./acre; or demand exceeds 100% system capacity.	N/A	Major system failures or supply contamination.
			Voluntary- reduce landscape irrigation water use by 50%.	Voluntary- reduce industry water consumption by 25%	All non-essential water use is prohibited.	N/A	Water rationing may be put into effect.
Terrell County WCID #1 (Sanderson)	Edwards-Trinity (Plateau)	Base on system capacity limits.	Daily water demand reaches or exceeds 80% of the system's capacity for 5 consecutive days.	Daily water demand reaches or exceeds 90% of the system's capacity for 5 consecutive days.	Daily water demand reaches or exceeds 100% of the system's capacity for 2 consecutive days.	N/A	N/A
			Inform the public.	All non-essential water use is prohibited.	Prohibit outside water use.	N/A	N/A
Town of Anthony	Hueco-Mesilla Bolson	Base on system capacity limits.	Daily water demand exceeds 90% of the system's capacity for 3 consecutive days; equipment or system failure occurs that limits the capacity of the system below 85% during high demand periods.	Daily water demand exceeds 90% of the system's capacity for 3 consecutive days; equipment or system failure occurs that limits the capacity of the system below 75% during high demand periods.	Daily water demand exceeds 98% of the system's capacity for 3 consecutive days; equipment or system failure occurs that limits the capacity of the system below 70% during high demand periods.	N/A	Major system failures or supply contamination.
			Voluntary- reduce water demand by 1-5%	Reduce water demand by 5-10%	Reduce water demand by 10-15%	N/A	Water rationing may be put into effect.

7.3.6 Groundwater Conservation District Drought Management

A discussion of the creation and the goals of the six Groundwater Conservation Districts (GCDs) formed in Far West Texas are discussed in more detail in Chapter 5 - Section 5.3. This section will focus on summarizing drought management by the Districts.

Six districts are currently in operation within the planning region:

- Brewster County GCD (http://westtexasgroundwater.com)
- Culberson County GCD (http://culbersonwaterdistrict.net)
- Hudspeth County UWCD #1
- Jeff Davis County UWCD
- Presidio County UWCD
- Terrell County GCD (http://co.terrell.tx.us/default.aspx?Terrell_County/Ground.Water)

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.

7.3.6.1 Brewster County Groundwater Conservation District

Management Objective – file and discuss at each meeting of the Board, drought emergency contingency plans received since the previous meeting.

The District, in partnership with the landowners of the District, hopes to monitor changing storage conditions of groundwater due to drought conditions.

7.3.6.2 Culberson County Groundwater Conservation District

Management Objective – monitor the PDSI and report findings and actions to the District Board on a quarterly basis.

7.3.6.3 Hudspeth County Underground Water Conservation District No. 1

Management Objective – the annual amount of groundwater permitted by the District for withdrawal from the portion of the Bone Spring-Victorio Peak aquifer located within the District may be curtailed during periods of extreme drought in the recharge zone of the aquifer or because of other conditions that cause significant declines in groundwater levels. Such curtailment may be triggered by the District's Board based on the groundwater levels measured in the District's monitoring well(s).

7.3.6.4 Jeff Davis County Underground Water Conservation District

Management Objective – the District will monitor the PDSI and report to the Board, the number of times the District experiences PDSI of less than one (mild drought). If PDSI indicates that the District will experience severe drought conditions, the District will notify all public water suppliers within the District.

7.3.6.5 Presidio County Underground Water District

Management Objective – the District will monitor the PDSI and report to the Board, the number of times the District experiences PDSI of less than one (mild drought). If PDSI indicates that the District will experience severe drought conditions, the District will notify all public water suppliers within the District.

7.3.6.6 Terrell County Groundwater Conservation District

Management Objective – the District will access the PDSI map and will check for updates to the Drought Preparedness Council Situation Report and discuss current drought conditions during at least one Board meeting a year.

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 an interconnected facility, 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 more specific information regarding facility locations to remain confidential. This section provides general information regarding existing and potential emergency interconnects among water user groups within Far West Texas.

Major water infrastructure facilities with the potential to interconnect with other utilities were identified through a survey process in order to better evaluate existing and potentially feasible emergency interconnects. Six potential interconnects are identified as shown in Table 7-2. Additional water supply is also available to EPWU during an emergency shortage of water, via the Desalination Plant.

Table 7-2. Potential Emergency Interconnects to Major Water Facilities

Entity Providing Supply	Entity Receiving Supply
Lower Valley Water District	El Paso WCID #4 Fabens
	El Paso Co. Tornillo WID
	Horizon Regional MUD
	Clint
EPWU	Town of Anthony
Fort Davis Estates	Fort Davis

7.5 EMERGENCY RESPONSES TO LOCAL DROUGHT CONDITIONS

Texas Statute §357.42(g) requires regional water planning groups to evaluate potential temporary emergency water supplies for all County-Other WUGs and municipalities with 2010 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. This review was limited and did not require technical analyses or evaluations following in accordance with 31 TAC §357.34.

There are 12 municipal and County-Other entities in the Region that have a 2010 Census population of less than 7,500 and rely upon a sole source of water. Eleven entities rely on groundwater and one (City of Clint) relies on water purchased from another entity. Potential emergency water supply sources that might be used by these small sole-source municipal or County-Other entities 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 entities, the addition of a new local groundwater well along with trucking in water was identified by all entities as a potential emergency water supply source. The City of Clint and the City of Presidio would also consider the curtailment of proximal water rights 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	2020 Population	2020 Demand	Curtailment of upstream/downstream water rights	Additional groundwater well	Brackish groundwater limited treatment	Brackish groundwater desalination	Emergency interconnect	Trucked - in water	Type of infrastructure required	Entity providing supply	Other local entities required to participate	Emergency agreements already in place
Alpine	Brewster	6,066	1,935		▪				▪				
Anthony	Brewster	6,210	734		▪			▪	▪	Pipeline; Truck	EPWU		General
Clint	El Paso	926	92	▪	▪			▪	▪	Pipeline; Truck	LVWD	LVWD	
El Paso Co. Tornillo WID	El Paso	2,790	279		▪			▪	▪		LVWD		
El Paso WCID 4 Fabens	El Paso	8,858	811		▪			▪	▪		LVWD		
Fort Davis	Jeff Davis	1,264	297		▪			▪	▪	Pipeline; Truck	Fort Davis Estates		
Marfa	Presidio	2,203	589		▪				▪				
Presidio	Presidio	4,867	659	▪	▪				▪	Trucks			
Sanderson	Terrell	889	202		▪				▪	Trucks		Terrell Co. WCID 1	
Sierra Blanca	Hudspeth	620	151		▪		▪	▪	▪	Trucks		Hudspeth Co. WCID 1	General
Van Horn	Culberson	2,319	662		▪				▪	Trucks			
Valentine *(County-Other)*	Jeff Davis	1,134	168		▪				▪				

In order 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 at: https://www.tceq.texas.gov/drinkingwater/trot/droughtw.html.

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, <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.

Other TCEQ Guidance resources:

- Emergency and Temporary Use of Wells for Public Water Supplies (RG-485)
- https://www.tceq.texas.gov/publications/rg/rg-485.html
- Questions from the TCEQ's Workshops on Drought Emergency Planning: Answers to Help Drinking-Water Systems Prepare for Emergencies https://www.tceq.texas.gov/assets/public/response/drought/workshop-questions071312.pdf
- Video: Workshop on Drought Emergency Planning for Public Water Systems in Texas http://www.youtube.com/watch?v=BdlF9CEcGPI&feature=plcp&context=C34378a7UDOEgsToPDskJNYWXf5I3pKq8tW9pkVqQU

7.6 REGION-SPECIFIC MODEL DROUGHT 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 drought contingency plans. The RWPGs shall develop region-specific model drought contingency plans that shall be presented in the RWP which shall be consistent with 30 TAC Chapter 288 requirements.

A new component of the planning process introduced in this planning cycle is Regional Drought Planning, which essentially expands the conceptualization and application of drought planning by specific entities to encompass the entire Far West Texas Region. The approach utilized in developing a region-specific drought plan considers 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, 3) identify potential monitoring stations with publicly accessible real-time data that currently exist, 4) determine how these data can be utilized for the water user groups that do are not subject to existing DCPs, and ultimately 5) development of a regional model drought contingency plan.

As discussed in Section 7.2, numerous groundwater conservation districts, irrigation districts, municipalities, and various public supply systems have written drought management plans or drought contingency plans and have provided them for inclusion in the Regional Plan.

7.6.1 Regional Groundwater Resources and Monitoring

Nine groundwater sources identified within Far West Texas and their contribution to total regional groundwater supply, based upon historical pumping averages for years 2007 through 2011, are:

- Bone Spring-Victorio (21%)
- Capitan Reef Complex (3%)
- Edwards-Trinity (Plateau) (less than 1%)
- Hueco-Mesilla (37%)
- Igneous (3%)
- Marathon (less than 1%)
- Rustler (less than 1%)
- West Texas Bolson (14%)
- Other (21%)

Current drought contingency plans are detailed in Section 7.3.5 and Table 7-1. 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 7-12.

Table 7-4. Current Municipal Trigger Monitoring Wells

Water Supply Entity	County	Water Supply Source	Well ID
City of Alpine	Brewster	Igneous	52-35-402 (Meriweather #1)
City of Alpine	Brewster	Igneous	52-35-401 (Meriweather #2)
City of Marfa	Presidio	Igneous	51-48-604
City of Marfa	Presidio	Igneous	51-48-603 (Well Q-7 in TBWE Bull)
City of Marfa	Presidio	Igneous	51-48-601 (Well Q-5 in TBWE Bull)
City of Marfa	Presidio	Igneous	51-48-602 (Well Q-6 in TBWE Bull)
El Paso County Tornillo WID	El Paso	Hueco-Mesilla Bolson	49-40-502 (Well #1)
Horizon Regional MUD	El Paso	Hueco-Mesilla Bolson	49-22-627
Terrell County WCID #1	Terrell	Edwards-Trinity (Plateau)	53-53-803
Terrell County WCID #1	Terrell	Edwards-Trinity (Plateau)	53-53-804
Terrell County WCID #1	Terrell	Edwards-Trinity (Plateau)	53-53-805
Terrell County WCID #1	Terrell	Edwards-Trinity (Plateau)	53-53-806
Terrell County WCID #1	Terrell	Edwards-Trinity (Plateau)	53-53-808
Terrell County WCID #1	Terrell	Edwards-Trinity (Plateau)	53-53-809
Terrell County WCID #1	Terrell	Edwards-Trinity (Plateau)	53-53-810
Terrell County WCID #1	Terrell	Edwards-Trinity (Plateau)	53-53-903

The previous 2006 and 2011 Far West Texas 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 Plan, with an updated status and history of measurements.

Table 7-5. 2011 RWP Groundwater Trigger Monitoring Wells

Aquifer	County	Well ID	Monitoring Agency	Period of Record & Measurement Count	Current Status
Igneous	Brewster	52-35-709 (Cartwright Well)	TWDB	1958-2014 (95 measurements)	Active
Marathon	Brewster	52-55-106	Registered Driller	2008 (1 measurement)	Unknown
Lobo	Culberson	51-02-903	TWDB	1950-2014 (61 measurements)	Active
Wild Horse	Culberson	47-59-106	TWDB	1953-2014 (59 measurements)	Active
Hueco Bolson	El Paso	49-13-710 (EPWU #67)	City	1968-2009 (50 measurements)	Unactive (plugged - 2009)
Mesilla Bolson	El Paso	49-04-138 (JL-EPWU #117)	USGS	1952-2010 (46 measurements)	Unknown
Rio Grande Alluvium	El Paso	49-04-701	U.S. Bureau of Reclamation	1946-1990 (532 measurements)	Unknown
Bone Spring-Victorio	Hudspeth	48-07-516	TWDB	1966-2014 (902 measurements)	Active
Ryan Flat	Jeff Davis	51-19-902 (2 Section Well)	TWDB	1955-2014 (56 measurements)	Active
Edwards-Trinity (Plateau)	Terrell	53-53-601	Terrell County WCID #1	1986 (1 measurement)	Unknown

The TWDB has recently created a component of their website called Water Data for Texas 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 20 groundwater wells located within Far West Texas, with their locations included on Figure 7-12.

Table 7-6. Currently Active (Real-Time) Monitoring Wells
Source: Water Data for Texas

County	State Well Number	Aquifer	Aquifer Type	Entity/Cooperator	Data Transmission	Start Date - Period of Record
Brewster	5235710	Igneous	Unconfined	Sul Ross State University	Satellite	3/3/2009
Brewster	5248301	Capitan Reef Complex	Unconfined	Middle Pecos GCD	Satellite	3/28/2008
Brewster	7347404	Other	Unconfined	Texas Water Development Board	Satellite	5/9/2007
Culberson	4759123	Other	Unconfined	Texas Water Development Board	Satellite	6/10/1996
Culberson	4759212	West Texas Boslon	Unconfined	Sul Ross State University	Satellite	3/3/2009
Culberson	5110305	West Texas Boslon	Unconfined	Sul Ross State University	Satellite	2/26/2009
El Paso	4904474	Other	Unconfined	U.S. Geological Survey	Satellite	10/15/2013
El Paso	4904475	Other	Unconfined	U.S. Geological Survey	Satellite	10/15/2013
El Paso	4904476	Hueco-Mesilla Bolson	Unconfined	U.S. Geological Survey	Satellite	10/15/2013
El Paso	4904477	Hueco-Mesilla Bolson	Unconfined	U.S. Geological Survey	Satellite	10/15/2013
El Paso	4913301	Hueco-Mesilla Bolson	Unconfined	Texas Water Development Board	Satellite	12/5/2002
Hudspeth	4807516	Bone Spring-Victorio Peak	Unconfined	Texas Water Development Board	Satellite	3/10/1966
Hudspeth	4815903	Bone Spring-Victorio Peak	Unconfined	Sul Ross State University	Satellite	3/21/2006
Jeff Davis	5124901	Igneous	Unconfined	Sul Ross State University	Satellite	9/26/2011
Jeff Davis	5225209	Igneous	Unconfined	Texas Water Development Board	Satellite	9/5/2001
Jeff Davis	5225509	Igneous	Unconfined	Sul Ross State University	Satellite	2/23/2009
Jeff Davis	5234302	Igneous	Unconfined	Sul Ross State University	Satellite	2/26/2009
Presidio	5129805	West Texas Boslon	Unconfined	Texas Water Development Board	Satellite	9/15/1993
Presidio	5148604	Igneous	Unconfined	Sul Ross State University	Satellite	2/26/2009
Presidio	7430813	West Texas Boslon	Unconfined	Sul Ross State University	Satellite	2/25/2009

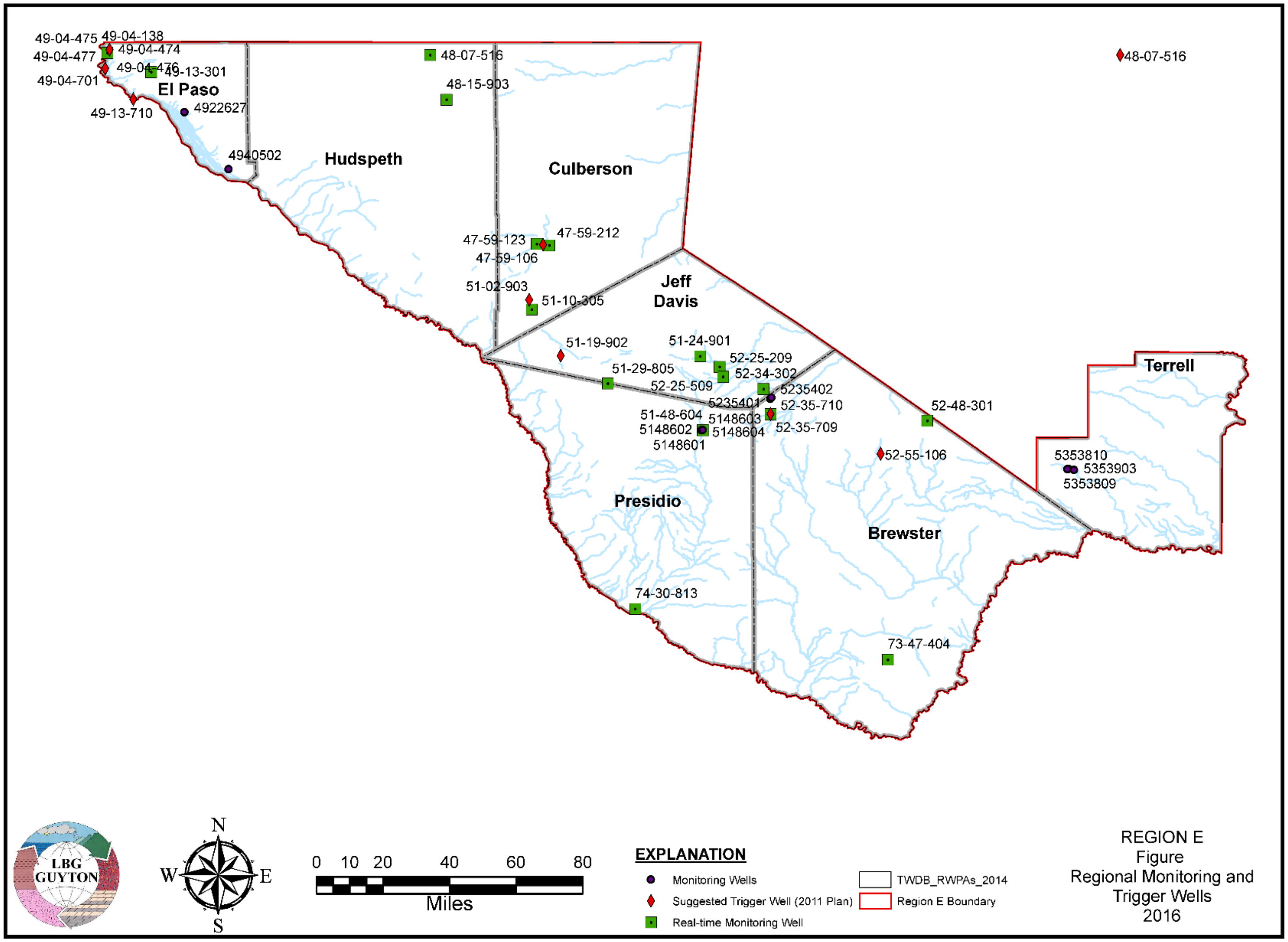


Figure 7-12. Regional Monitoring and Trigger Wells

7.6.2 Regional Surface Water Resources

Surface water sources identified within Far West Texas and their contribution to total regional surface water supply are:

- Upper Rio Grande (52%)
- Upper Rio Grande Return Flows (33%)
- Lower Rio Grande (15%)
- Pecos River (<1%)

The basin contribution to the regional supply calculation is based upon the WAM Run 3 (Full Authorization) availability numbers.

A list of selected currently active stream flow and spring flow and gaging stations are listed in Table 7-7. International Boundary Water Commission (IBWC) and U.S. Geological Survey (USGS) gaging stations located along the Rio Grande between the Rio Conchos and the Pecos River are presented on Figure 7-13. There are five stations that are currently operating in this reach of the Rio Grande. The IBWC and USGS stations have real-time data that is publicly accessible online.

Table 7-7. Currently Active Surface Water Gaging Locations, USGS, IBWC

County	Station ID	Station Name	Agency	Period of Record	Measurement Frequency
Presidio	08-3742.00	Rio Grande below Rio Conchos near Pesidio, Texas	IBWC	1900-2014	15 minutes
Presidio	08-3743.00	Rio Grande below Mulato Dam near Redford, Texas	IBWC	2014	15 minutes
Brewster	08-3750.00	Rio Grande at Johnson Ranch near Castolon, Texas	IBWC	1936-2014	15 minutes
Brewster	08374550	Rio Grande near Castolon, Texas	USGS	2007-2014	Daily
Brewster	08375300	Rio Grande at Rio Grande Village, BBNP	USGS	2007-2014	Daily
Reeves	08427000	Giffin Springs at Toyahville, Texas	USGS	1931-2014	Daily

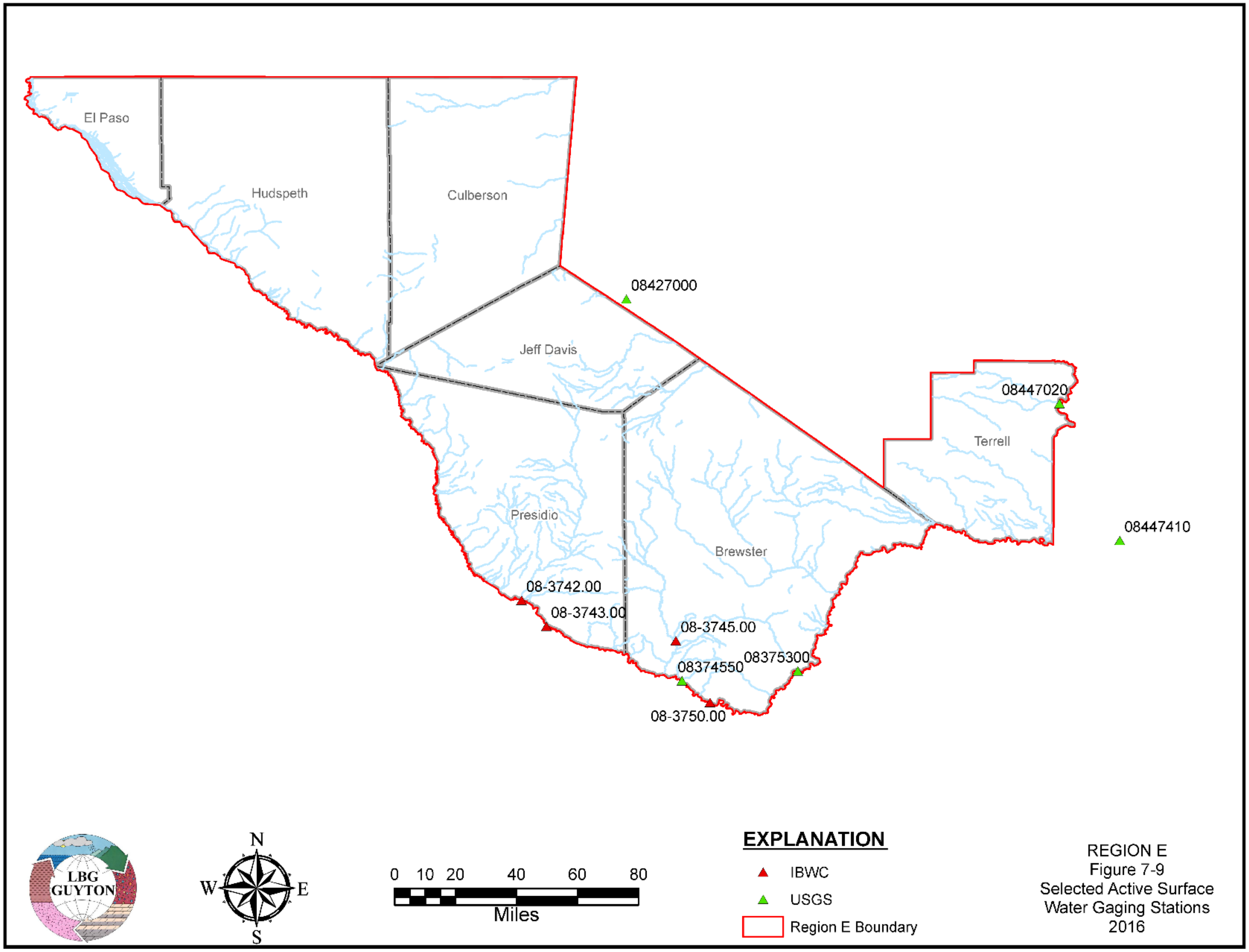


Figure 7-13. Selected Active Surface Water Gaging Locations

7.6.3 Regional Model Drought Contingency Plan

The Regional Model DCP summary Table 7-8 provides an overview of all existing regional water sources, WUGs, monitoring wells, 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 Region.

The Regional Model DCP will undoubtedly change over time in order to address particular needs and issues of the Region's users. Therefore, this initial version of the model 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 first 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. No triggers have been recommended for modification; however, an effort has been made to make the percent reduction of demand/use a little more aggressive and more equitable across the board. Additionally, 'voluntary conservation' has been removed as a stage 1 action. Conservation is a BMP that ideally will ultimately be practiced on a daily basis, 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) exempt water wells in counties with established GCDs, 2) users in Culberson and Hudspeth County outside of GCD boundaries, 3) and El Paso County users outside of EPWU distribution system.

This page intentionally left blank.

Table 7-8. Recommended Regional Drought Plan Triggers and Actions

Source Name	Source Type	Source User Entity	Current WUG Monitoring	Real-time Source Monitoring	Factors to be Considered	Recommendations	Specific Actions (Percent Reduction Demand/ Use)							
							Source Manager				Users			
							1	2	3	4	1	2	3	4
							Mild	Mod	Severe	Critical	Mild	Mod	Severe	Critical
Bone Spring - Victorio Peak	GW	County Other Irrigation Livestock	HCUWCD#1	48-07-516	District trigger and monitoring wells mentioned in GMP	Create a formal DCP with wells, triggers and repsonses	20	30	40	50	20	30	40	50
Capitan Reef Complex	GW	Irrigation	N/A	42-48-301	Non-potable supply.	N/A	N/A							
Edwards-Trinity (Plateau)	GW	Terrell County WCID #1 (Sanderson)	53-53-803, 53-53-804, 53-53-805, 53-53-806, 53-53-808, 53-53-809, 53-53-810, 53-53-903	N/A	District trigger and monitoring wells in place.	Create a formal DCP with wells, triggers and repsonses. Make stage 1 a mandatory 20% demand reduction.	20	30	40	50	20	30	40	50
		County Other Irrigation Livestock Mining	N/A	N/A	Subject to GCD management plans.	N/A	20	30	40	50	20	30	40	50
Hueco-Mesilla Bolson	GW	City of El Paso		49-04-476 or 477; 49-13-301	Plan in place.	Remove voluntary conservation as a stage. Make stage 1 a mandatory 20% demand reduction.	20	30	40	50	20	30	40	50
		City of Vinton			Purchases supply from El Paso.	Follow El Paso triggers and actions.								
		Lower Valley Water District			Multiple triggers in place.	Remove voluntary conservation as a stage. Make stage 1 a mandatory 20% demand reduction.	20	30	40	50	20	30	40	50
		Town of Clint			Purchase supply from LVWD.	Follow LVWD triggers and actions.	20	30	40	50	20	30	40	50
		City of San Elizario					20	30	40	50	20	30	40	50
		City of Socorro					20	30	40	50	20	30	40	50
		El Paso County Tornillo WID	49-40-502 (well 1)		N/A	Remove voluntary conservation as a stage. Make stage 1 a 20% demand reduction.	20	30	40	50	20	30	40	50
		El Paso County WCID #4			Plan in place.	Remove voluntary conservation as a stage. Make stage 1 a 20% demand reduction.	20	30	40	50	20	30	40	50

Table 7-8. (Continued) Recommended Regional Drought Plan Triggers and Actions

Source Name	Source Type	Source User Entity	Current WUG Monitoring	Real-time Source Monitoring	Factors to be Considered	Recommendations	Specific Actions (Percent Reduction Demand/ Use)							
							Source Manager				Users			
							1	2	3	4	1	2	3	4
							Mild	Mod	Severe	Critical	Mild	Mod	Severe	Critical
Hueco-Mesilla Bolson	GW	Fort Bliss		49-04-476 or 477; 49-13-301	Plan in place.	Add triggers and actions for Stage 1 to achieve 20% demand reduction.	20	30	40	50	20	30	40	50
		Horizon Regional MUD	49-22-627		Plan in place.	Remove voluntary conservation as a stage. Make stage 1 a 20% demand reduction.	20	30	40	50	20	30	40	50
		Town of Anthony			Plan in place.	Remove voluntary conservation as a stage. Make stage 1 a 20% demand reduction.	20	30	40	50	20	30	40	50
		County Other *Manufacturing* *Mining* *Power* *Livestock*	N/A	49-04-476 or 477; 49-13-301	No GCD.	N/A	20	30	40	50	20	30	40	50
Igneous	GW	City of Alpine	52-35-401 (Meriweather #2), 52-35-402 (Meriweather #1)	not needed	Plan in place.	Remove voluntary conservation as a stage. Make stage 1 a 20% demand reduction.	20	30	40	50	20	30	40	50
		City of Marfa	51-48-601, 51-48-402, 51-48-603, 51-48-604	not needed	Plan in place.	Remove voluntary conservation as a stage. Make stage 1 a 20% demand reduction.	20	30	40	50	20	30	40	50
		Fort Davis WSC	N/A	51-24-901, 52-25-209, 52-25-509, 52-34-302	Plan in place.	Add triggers and actions for Stage 1 to achieve 20% demand reduction.	20	30	40	50	20	30	40	50
		County Other *Irrigation* *Manufacturing* *Mining* *Livestock*	N/A	51-24-901, 52-25-209, 52-25-509, 52-34-302, 51-48-604	Subject to GCD management plans.	N/A	Follow GCD recommendations.							
Marathon	GW	*County Other* *Livestock*	N/A	N/A	Subject to GCD management plans.	N/A	Follow GCD recommendations.							
Rustler	GW	*County Other* *Mining* *Livestock*	N/A	N/A	NO GCD (Culberson). Non-potable supply.	N/A	20	30	40	50	20	30	40	50

Table 7-8. (Continued) Recommended Regional Drought Plan Triggers and Actions

Source Name	Source Type	Source User Entity	Current WUG Monitoring	Real-time Source Monitoring	Factors to be Considered	Recommendations	Specific Actions (Percent Reduction Demand/ Use)							
							Source Manager				Users			
							1	2	3	4	1	2	3	4
							Mild	Mod	Severe	Critical	Mild	Mod	Severe	Critical
West Texas Bolsons	GW	City of Presidio	N/A	74-30-813	Plan in place.	Remove voluntary conservation as a stage. Make stage 1 a 20% demand reduction.	20	30	40	50	20	30	40	50
		City of Van Horn	N/A	47-59-212, 47-59-106	Plan in place.	Remove voluntary conservation as a stage. Make stage 1 a 20% demand reduction. Add triggers to DCP.	20	30	40	50	20	30	40	50
		Hudspeth County WCID #1 (Sierra Blanca)			No DCP submitted.	N/A	20	30	40	50	20	30	40	50
		County Other *Irrigation* *Mining* *Livestock*	N/A	47-59-106, 47-59-212, 51-02-903, 51-10-305, 51-19-902, 51-29-805, 74-30-813	GCDs except in Hudspeth County.	N/A	20	30	40	50	20	30	40	50
Other - Rio Grande Alluvium (El Paso, Hudspeth)	GW	Horizon Regional MUD	N/A	N/A	Plan in place.	Remove voluntary conservation as a stage. Make stage 1 a 20% demand reduction.	20	30	40	50	20	30	40	50
		Mining *Irrigation*	N/A	N/A	NO GCD.	N/A	20	30	40	50	20	30	40	50
Other - Cretaceous Limestones (Brewster)	GW	*Mining* *Irrigation* *Livestock*	N/A	N/A	Subject to GCD management plans.	N/A	Follow GCD recommendations.							
Other - Balmorhea Alluvium (Jeff Davis)	GW	*Livestock*	N/A	N/A	Subject to GCD management plans.	N/A	Follow GCD recommendations.							
Upper Rio Grande	SW	City of El Paso	EPCWID#1	USBR Elephant Butte Reservoir Dam	Rio Grande Project	No recommendations.	No recommendations.							

Table 7-8. (Continued) Recommended Regional Drought Plan Triggers and Actions

Source Name	Source Type	Source User Entity	Current WUG Monitoring	Real-time Source Monitoring	Factors to be Considered	Recommendations	Specific Actions (Percent Reduction Demand/ Use)							
							Source Manager				Users			
							1	2	3	4	1	2	3	4
							Mild	Mod	Severe	Critical	Mild	Mod	Severe	Critical
Lower Rio Grande	SW	Hudspeth County Irrigation		N/A		No recommendations.	No recommendations							
		Presidio County Irrigation		IBWC 08-3742.00 Rio Grande below Rio Conchos near Presidio, TX		No recommendations.								
Terlingua Creek	SW			IBWC 08-3745.00 Terlingua Creek near Terlingua, TX		No recommendations.								
Pecos River	SW			IBWC 08-4474.10 Pecos River near Langtry, TX		No recommendations.								
Phantom Creek	SW			Inactive (USGS 08425500)		No recommendations.								
Independence Creek	SW			USGS 08447020 Independence Creek near Sheffield, TX		No recommendations.								
Toyahville Springs	SW			USGS 08427000 Giffin Springs at Toyahville, TX		No recommendations.								

7.6.4 WUG-Specific Model Drought Contingency Plans

7.6.4.1 Public Water Supplier

Model drought contingency plans were developed for the Far West Texas region and can be accessed online at http://riocog.org/ENVSVCS/FWTWPG/docs.htm. Each plan identifies four drought stages: mild, moderate, severe and emergency. The recommended responses range from notification of drought conditions and voluntary reductions in the "mild" stage to mandatory restrictions during an "emergency" stage. Entities using the model plan can select the trigger conditions for the different stages and appropriate responses for each stage. Current triggers and response actions for participating entities are summarized in Table 7-9.

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 El Paso County except for those located within the City of El Paso's jurisdictional boundary.

7.6.4.3 Wholesale Water Provider

There are three wholesale water providers in the Far West Region:

- El Paso Water Utilities
- Lower Valley Water District.
- El Paso County WID #1

Currently adopted triggers and actions are summarized below in Table 7-. El Paso County WID#1 has not submitted a DCP.

Table 7-9. Wholesale Water Provider Drought Triggers and Response Actions

		Stage & Description				
WWP		**1 - Mild**	**2 - Moderate**	**3 - Severe**	**4 - Extreme**	**5 - Emergency**
El Paso Water Utilities	Trigger	EPCWID decreases allotment less than 0.5 acre foot per acre on or before April 1; water demand is projected to exceed EPWU system capacity.	EPCWID decreases allotment less than 1.0 acre foot per acre on or after April 1 but before May 1 or there is not a continuous release of surface water; water demand is projected to exceed EPWU system capacity.	EPCWID decreases allotment less than 1.5 acre foot per acre after May 1 but before May 15 or there is not a continuous release of surface water; water demand is projected to exceed EPWU system capacity.	N/A	N/A
El Paso Water Utilities	Conservation Goal (percent reduction in pumpage)	Voluntary- reduce water demand by 25%.	Mandatory- lawn watering schedule.	Set limits on water consumption; prohibit use of specific outdoor watering activities.	N/A	N/A
Lower Valley Water District	Trigger	Water stored in Elephant Butte Reservoir is less than 50,000 acre-feet; surface water allotment is less than or equal to 3.0 acre-ft./acre; or demand exceeds 90% system capacity.	Surface water allotment less than or equal to 2.5 acre-ft./acre; or demand exceeds 95% system capacity.	Surface water allotment less than or equal to 2.0 acre-ft./acre; or demand exceeds 100% system capacity.	N/A	Major system failures or supply contamination.
Lower Valley Water District	Conservation Goal (percent reduction in pumpage)	Voluntary- reduce landscape irrigation water use by 50%.	Voluntary- reduce industry water consumption by 25%	All non-essential water use is prohibited.	N/A	Water rationing may be put into effect.

CHAPTER 8

POLICY RECOMMENDATIONS AND UNIQUE SITES

This page intentionally left blank.

8 POLICY RECOMMENDATIONS AND UNIQUE SITES

An important aspect of the regional water planning process is the opportunity for the Far West Texas Water Planning Group (FWTWPG) to discuss policy issues that are important to this Region and provide recommendations for the improvement of future water management planning in Texas. The recommendations 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. Specific policy issues that are relevant to Far West Texas and possibly the rest of the State are presented in the following Recommendation section. This chapter also addresses recommendations of “Ecologically Unique River and Stream Segments” and considerations of “Unique Sites for Reservoir Construction”.

The FWTWPG approves of the legislative intent of the regional water planning process and supports the continuance of water planning at the regional level. However, the FWTWPG suggests that the Legislature and TWDB consider the following changes to the regional water planning process.

8.1 POLICY AND PLANNING RECOMMENDATIONS

The following recommendations are intended to address regulatory, administrative and legislative issues related to water supply management planning. Some of the recommendations listed below may at first appear to be redundant, but each of them emphasizes a slightly different point. Several related points in the interest of specificity were intentionally refrained from being combined.

1. **Re-emphasis of the Planning Function of the Regional Water Planning Group and Need for More Local Planning Initiatives**. The planning process increasingly focuses too heavily on meeting the technical requirements of the regional water planning process and the TAC rules, to the detriment of allowing for local planning initiatives. The role of the Regional Water Planning Group no longer seems to include "planning"; rather, it meets primarily to ratify deadlines and requirements of the TWDB. Certainly this seems to contradict the goal of Senate Bill 1. Providing for more local influence of the process and reducing the numerous, standardized checklists of the requirements of the Plan would help. The planning process and the ultimate Plan must be flexible because of the unique characteristics of the border region. The FWTWPG should have the legal ability to consider all water resources available to the Region, regardless of whether or not they are located within Texas.

2. **Wastewater and Stormwater Planning**. In this particular region because "water is water", future planning should include wastewater and stormwater. Effective stormwater planning will be beneficial to regional water resources including aquifer recharge and optimization of surface water resources.

3. **Elimination of Unfunded Mandate**. The current regulations of the TWDB require local entities to pay for 100 percent of the administrative costs of developing the plans. This is difficult to sell when a local government has to tell its constituents that they have to do with one less full-time deputy, a lower level of funding for the library, and no new fire truck – but that they can afford to pay for a water plan. Trying to force local "buy-in" by requiring local funding causes resentment of the process and antagonism toward the plan. The State should pay for what the State thinks is important. The current 100/100 Plan is an improvement over the original concept (pursuant to which the State was to pay for 75 percent of everything, including administration), but it is still an unfunded mandate, and is still a bad idea – no matter how good the idea being funded.

4. **Modification of Demand Numbers**. 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. Demand tables should also show different numbers based on different growth and population scenarios. The manner in which the irrigation and livestock demand numbers increase during drought scenarios is inappropriate because other factors influence the demand. For example, during a drought in Far West Texas, livestock are sold, thus reducing the overall demand on groundwater. There needs to be a better understanding of the process of how livestock, drought and water demand interact, and this understanding needs to be reflected in the demand numbers.

5. **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, modeling, and to obtain more data on the West Texas aquifers. Specific data-need recommendations for the rural areas are

included in the "Data Needs" section. The FWTWPG should be allowed to request additional funding for the data needs and contract for the studies.

6. **Open Records Exception for Private Water Data**. The regional water planning process is predicated on the planning group's gathering thorough and complete data about water supplies within the planning area in order to inventory and evaluate the water resources. The problem with that predicate is that, given current law, most landowners are not going to give planning groups or groundwater conservation districts any information about their water. Under current law, if landowners give data about their water to the water planning groups, they are also giving it to anybody that wants it. The landowner's position will be that "My wells, my springs, and my tanks - where they are located, how deep they are, what their capacity is, and the quality of the water - are my business. They are not the State's business, and they are not the public's business." This is counter-productive to the data collection that is necessary to effective water planning. The solution is an amendment to the Open Records Act that (1) excepts or exempts any water data from private lands without the landowner's prior written consent and (2) prohibits the TWDB and the TCEQ and all other state agencies from sharing any water data with any other person or agency without the landowner's prior written consent and (3) requires the TWDB and the TCEQ to treat all water data as confidential. The second and third need to have some teeth, such as criminal sanctions and/or personal liability for knowing or intentional violations without the need to prove damages. If we do not make this change, we are not going to get the data we need to plan effectively.

7. **Plan Implementation**. Implementation of the plan's recommendations must be the responsibility of the local governments, entities, and individuals within the region. The Water Planning Group is not intended to assume a supervisory or command-and-control role. The Water Planning Group's function will be to monitor implementation and assist the local governments, entities, and individuals within the region as requested.

8. **State Mandated Water Planning**. State mandated water planning for this region began in 1999. The water plan to be completed in 2021 will be the fifth round of planning. The details of water planning in this region are not changing dramatically over five year periods. Funding is needed for the implementation of the water supply projects presented in the Water Plan.

9. **Regional Planning Cycles**. Conclusions of regional planning cycles should not overlap with legislative sessions. Although this did not occur during the current planning period, future planning schedules could be impacted. This makes informed and current water planning extremely difficult, as numerous water bills maybe pending that could impact regional water planning and that likely will not be resolved until the 11^{th} hour of the session. Regional water planners should not be put in the untenable position of either having to divine the future of water law or to rely upon statutes that may change literally the day after our plan is turned into the state.

10. **GMA Cycles**. Another related issue is with the need for better coordination in the planning activity cycles related to the timing of due dates in the Groundwater Management Area (GMA) process, groundwater conservation district management plans, and regional and state water plans. The *managed available groundwater* (MAG) volumes determined in the GMA process for each aquifer are to be incorporated into groundwater conservation district management plans, and are required in the regional water planning process of assessing water supply availability. By

rescheduling the due dates in the GMA process, MAG data can be better integrated into the overall state water planning program.

11. **Colonias**. Far West Texas contains a significant portion of the colonias in the State of Texas. While much effort has gone into rectifying the substandard water and wastewater conditions in the region (see Section 1.10 in Chapter 1 of this *Plan*), many of these economically distressed neighborhoods continue to exist. The FWTWPG encourages State and Federal agencies to continue their financial programs so that all citizens, regardless of their social and economic status, can be provided with a safe and healthy living environment.

12. **Data Needs**.

- There is a concern that some historical irrigation pumpage reported by the TWDB is inaccurate. The TWDB should continue its irrigation surveys and attempt to improve the estimates with the assistance of local irrigation and groundwater districts.
- A study should be performed to evaluate the feasibility and potential benefits of rechanneling a segment of the Rio Grande below Fort Quitman.
- A significant amount of groundwater is produced from Cretaceous limestone formations in southern Brewster County that exist outside the boundary of the Edwards-Trinity (Plateau) Aquifer. The communities of Lajitas, Terlingua, and Study Butte, along with other rural users rely on this sole source of water to meet their daily needs. An aquifer characterization study is needed to estimate its vertical and lateral extent, sustainable yield, and water quality.
- Provide funding for the development of the Transboundary Aquifer Model of the Mesilla Bolson. Ciudad Juarez has built the infrastructure needed to capture groundwater from the Conejos Medanos Aquifer, which is the southern extension of the Mesilla Bolson. Development of this regional model, will allow water quantity and quality impacts to be evaluated.
- Additional data should be requested from water agencies in Mexico to be used to extend the Presidio Bolson GAM to both sides of the Rio Grande.
- An Integrated Rio Grande Data Management System allowing for regional coordination of the Rio Grande for better management and decision making of irrigation releases and flood control is needed.
- The Rio Grande Project delivery system is in need of a real time water quantity and water quality monitoring system so that agriculture, municipal and regulatory agencies can better manage and account for the water. The benefits would improve efficiency, flood control management and warnings of contaminant releases. Thus information systems analysis and hydrologic operations modeling are recommended.
- Provide funding for the Rio Grande Salinity Management Coalition (RGSMC). The goal of the coalition is to ultimately reduce salinity concentrations in the Rio Grande, which will allow increased beneficial use of the water for agriculture, urban and environmental purposes.

8.2 ECOLOGICALLY UNIQUE RIVER AND STREAM SEGMENTS

As a part of the planning process, each regional planning group may include recommendations for the designation of ecologically unique river and stream segments in their adopted regional water plan (31 TAC 357.8). The Texas Legislature may designate a river or stream segment of unique ecological value following the recommendations of a regional water planning group. As per §16.051(f) of the Texas Water Code, this designation solely means 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 segment designated by the legislature under this subsection.

Stream segment designation is to be supported by a recommendation package that includes a physical description, maps, photographs, literature citations, and data pertaining to each candidate stream segment. In accordance with the TWDB's rules, the following criteria are to be used when recommending a river or stream segment as being of unique ecological value:

- **Biological Function –** 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;
- **Hydrologic Function –** Segments which are fringed by habitats that perform valuable hydrologic functions relating to water quality, flood attenuation, flow stabilization, or groundwater recharge and discharge;
- **Riparian Conservation Areas –** 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 under a governmentally approved conservation plan;
- **High Water Quality/Exceptional Aquatic Life/High Aesthetic Value –** 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
- **Threatened or Endangered Species/Unique Communities –** Sites along segments where water development projects would have significant detrimental effects on state or federally listed threatened and endangered species, and sites along segments that are significant due to the presence of unique, exemplary, or unusually extensive natural communities.

A quantitative assessment of how recommended water management strategies (Chapter 5) potentially could affect flows deemed important by the FWTWPG to the Ecologically Unique River and Stream Segments was performed by considering the following criteria:

- Distance from the strategy supply source to the EURSS
- Does the strategy groundwater supply source (aquifer) contribute flow to the EURSS
- Does the strategy surface water supply source (Rio Grande) contribute flow to the EURSS
- Percent diminished flow to the EURSS resulting from implementation of the strategy

The FWTWPG chooses to respect the privacy of private lands and therefore continues to support the *2006 and 2011 Plan* "Ecologically Unique River and Stream Segments" recommendations of three streams that lie within the boundaries of state-managed properties, three within National Park boundaries, and specified streams managed by the Texas Nature Conservancy as listed below (Figure 8-1). Notification was given to the general public that the FWTWPG would consider river and stream segments on private property only if requested by the landowner.

- **Rio Grande Wild and Scenic River (Big Bend)** primarily depends on flows from the Rio Conchos and from springs and spring-fed tributaries along the Big Bend stretch of the River. No strategies occur in the aquifers that feed the springs and tributaries. Historically, the Upper Rio Grande (El Paso and Hudspeth Counties) flowed almost unabated through the Far West Texas stretch of the River. However, with today's upstream water demands on the River, only a minor flow from the Upper Rio Grande segment manages to periodically contribute to the Lower Rio Grande segment (Presidio, Brewster and Terrell Counties). Strategies presented in this plan do not significantly reduce this downstream contribution.
- **McKittrick Canyon and Chosa Creek (Guadalupe Mountains National Park)** are spring fed at high elevations of the Capitan Reef Aquifer within the Park. Potential groundwater pumped and transported from the Diablo Farms section of the Capitan Reef Aquifer (Strategy E-22) is separated from the spring sources by distance, faulting and elevation. Also, pumping and transport of groundwater from the Bone Springs – Victorio Peak Aquifer in the Dell City area (Strategy E-23) is also separated from the spring sources by distance, faulting and elevation. Thus, pumping from these aquifers should have no impact on aquifer sources that contribute to springflow.
- **Cienega Creek (Chinati Mountains State Natural Area)** is spring fed from high elevation exposures of the Davis Mountains Igneous Aquifer. Three strategies, (E-50 and E-51 in Fort Davis; and E-52 in Marfa) consider pumping projects in the Igneous Aquifer. However, all three pumping locations are distant from this designated stream and thus will have no water flow impact.
- **Alamito and Cienega Creeks (Big Bend Ranch State Park)** are spring fed from high elevation exposures of the Davis Mountains Igneous Aquifer. Three strategies, (E-50 and E-51 in Fort Davis; and E-52 in Marfa) consider pumping projects in the Igneous Aquifer. However, all three pumping locations are distant from this designated stream and thus will have no water flow impact.
- **Alamito Creek (Trans Pecos Water Trust)** is spring fed from high elevation exposures of the Davis Mountains Igneous Aquifer. Three strategies, (E-50 and E-51 in Fort Davis; and E-52 in Marfa) consider pumping projects in the Igneous Aquifer. However, all three pumping locations are distant from this designated stream and thus will have no water flow impact.
- **Independence Creek (Texas Nature Conservancy – Independence Creek Preserve)** is spring fed from the Edwards-Trinity (Plateau) Aquifer. Only one strategy (E-64 Terrell County Mining) considers additional well pumping from the Edwards-Trinity (Plateau) Aquifer. However, this pumping is distant from this designated stream segment and thus will have no water flow impact.
- **Madera Creek, Canyon Headwaters of Limpia Creek, Little Aguja Creek, and Upper Cherry Creek (Texas Nature Conservancy – Davis Mountains Preserve)** are spring fed from high elevation exposures of the Davis Mountains Igneous Aquifer. Three strategies, (E-50 and E-

51 in Fort Davis; and E-52 in Marfa) consider pumping projects in the Igneous Aquifer. However, all three pumping locations are distant from this designated stream and thus will have no water flow impact.

New to the *2016 Plan* is an additional recommendation that the Terlingua Creek segment exclusively within the boundaries of the Big Bend National Park be considered for "Ecologically Unique River and Stream Segment" status (Appendix 8A).

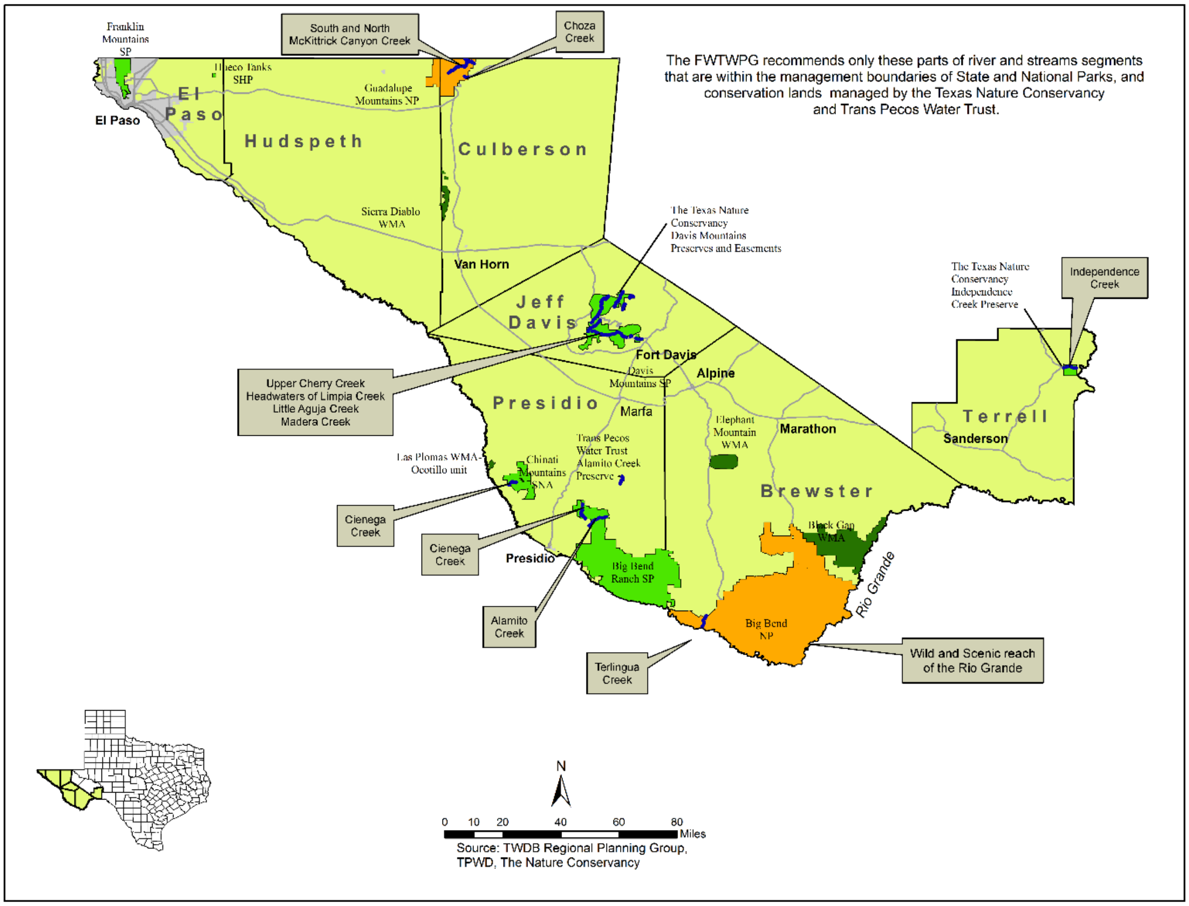


Figure 8-1. Recommended Ecologically Unique River and Stream Segments

8.3 CONSIDERATION OF UNIQUE SITES FOR RESERVOIR CONSTRUCTION

The regional water planning process gives each of the 16 regional water planning groups the opportunity to recommend stream locations for designation as "Unique Sites for Reservoir Construction". The regional water planning process legislation and rules list many criteria to determine if a site is qualified for such designation.

The availability of water is one of the most important criteria in the selection of a reservoir site - if not the most important criterion. The low rainfall totals and the spotty nature of precipitation in Far West Texas limit the potential for sufficient runoff to maintain desired water levels in reservoirs.

Many canyons in the mountainous areas of Far West Texas might not retain large volumes of water because of the fractured and often highly permeable bedrock that forms the walls and floors of these topographic features. Any attempt to develop a reservoir in Far West Texas will require extensive and costly geological, geotechnical, and hydrological investigations to determine whether a site is suitable. The program of work would also require detailed state and federal environmental impact assessments.

With regard to the Rio Grande, the 1944 International Treaty between the United States and Mexico specifies that a reservoir project considered by one country have the other country's permission. Furthermore, the treaty stipulates that international reservoirs are to be operated by both countries.

On watercourses other than the Rio Grande, the water use reported to the TCEQ by surface water right holders gives some clues as to which watercourses are the most reliably used and therefore could be investigated for potential reservoir sites. Reported water use data, provided by the Rio Grande Watermaster and by TCEQ, have been examined to identify holders of surface water rights who are able to divert water in amounts greater than 1,000 acre-feet per year. The analysis indicates that Musquiz and Maravillas Creeks in Brewster County are probably the most reliable surface water sources.

On Alamito Creek in Presidio County, there is an existing recreational reservoir authorized to impound 18,700 acre-feet, but diversions are not authorized and therefore no use amounts are reported. Whether this reservoir stays reliably full is unknown, and the reliability of Alamito Creek in general is unknown.

A feasibility study for a recreational lake site near Alpine was previously conducted and consideration was given to its municipal water supply potential. The project was abandoned because of its high cost-to-yield potential.

Additional off-channel reservoir sites, as well as flood protection dam sites on major arroyos have been studied by the Hudspeth County Conservation and Reclamation District #1, El Paso-Hudspeth County Soil Conservation District, and the Hudspeth County Commissioners Court. None of these sites have been selected for construction. Additional flood retention dams have been considered for the El Paso area. These retention dams would have the added benefit of increasing recharge of the local aquifer by increasing infiltration of the retained water into the bolson deposits.

The firm yield for any reservoirs constructed on even the most reliable Far West Texas watercourses is not likely to exceed 2,000 acre-feet per year. For this reason, the *2016 Far West Texas Water Plan* does not recommend any watercourse for designation as "Unique Sites for Reservoir Construction."

APPENDIX 8A
TERLINGUA CREEK
(BIG BEND NATIONAL PARK)

This page intentionally left blank

Appendix 8A

Terlingua Creek (Big Bend National Park)

Terlingua Creek flows southeast for 83 miles from the confluence of the Paradise and Hackberry draws near the Presidio-Brewster County line to its confluence with the Rio Grande, which is located just east of the Santa Elena Canyon and approximately six miles northwest of Castolon, within Big Bend National Park.

The watershed captures several hundred square miles of runoff within the Chihuahua Desert lowlands between the Chisos Mountains to the east and the Mesa de Anguila to the west. The upper 50 miles of Terlingua Creek is an intermittent stream that transects "variable terrain surfaced by shallow, stony soils and sandy and clay loam that support Mexican buckeye, walnut, persimmon, desert willow, scrub brush, juniper, oak, chaparral, cacti, grasses, water-tolerant hardwoods, and conifers" (TSHA, 2010).

The reach of Terlingua Creek that is recommended as an ecologically unique stream segment is only that portion of the Creek located within Big Bend National Park. This proposed unique segment is approximately five miles in length (Figure 8A-1).

Spanish-speaking people settled in the area now known as Terlingua Abaja (Figure 8A-2), the original location of the town of Terlingua, which is located two miles north of the Rio Grande, prior to the discovery of quicksilver in the area in the 1880s. Cattle did not move into the Big Bend area until the 1880s, at which time, Richard Gano established the Estado Land and Cattle Company on 55,000 acres with its western boundary delineated at Terlingua Creek. A U.S. Geological Survey team member who camped in the Terlingua area in 1902 indicated "that the region was still pretty primitive with temporary cow camps in the area from time to time" (Ragsdale, 1976).

As late as 1885 (the year Gano established his cattle company) Terlingua Creek was described by his ranch foreman as a "bold running stream, studded with cottonwood timber and was alive with beaver" (Tyler, 1996). The most significant area of riparian forest that currently remains is located north of Terlingua Abajo.

The National Park Service is proposing a stream restoration project in the lowest portion of Terlingua Creek which will initially consist of planting coyote willows in an attempt to regain the stream channel and control high flow erosional scouring of the channel. Once the willows establish they will plant cottonwoods in an effort to restore the original riparian habitat.

Hydrological: The International Boundary and Water Commission (IBWC) established a tram-style stream gaging station (08-3745.00) at Terlingua Creek near Terlingua Abaja in 1932. Historical daily streamflow records are available from 1932 to present. The station currently has a real-time streamflow gage installed. Both the historic and the real-time data are available at: http://ibwc.state.gov/Water_Data/rio_grande_WF.html#Stream.

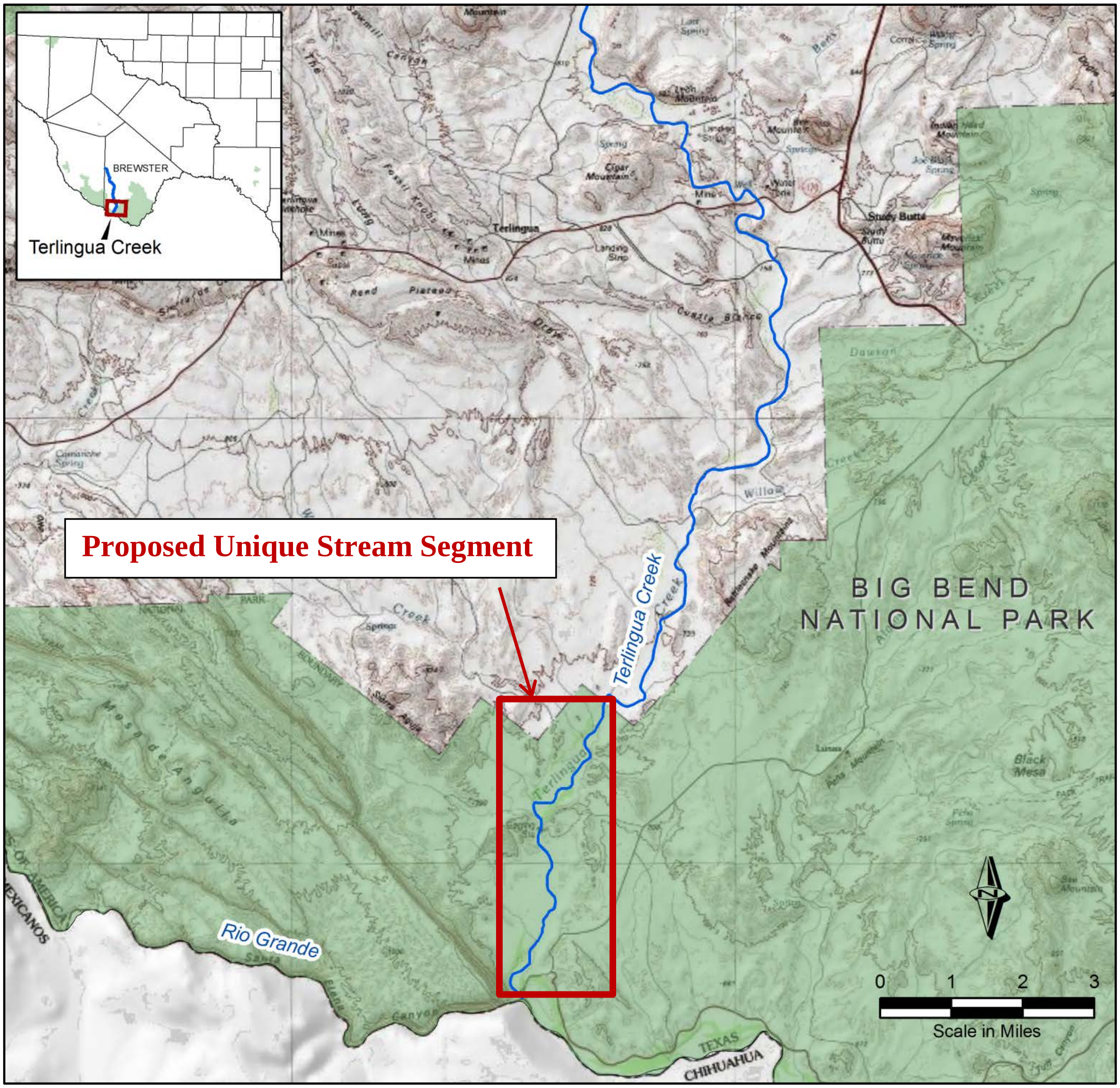


Figure 8A-1. Terlingua Creek

Figure 8A-2. Terlingua Abaja ruins.
Santa Elena Canyon can be seen in the distance in second photo. Views to the southwest and south.

Riparian Habitat: Terlingua Creek transects Big Bend National Park from the Rio Grande to the BBNP boundary located about five miles north of the river. The creek discharges to the Rio Grande immediately downstream of Santa Elena Canyon, an area of exceptional aesthetic value (Figure 8A-3). The stream channel has degraded over time and is no longer able to successfully flush the increasing fine sediment load into the Rio Grande.

Figure 8A-3. The confluence of the Terlingua Creek and the Rio Grande at Santa Elena Canyon. View is toward the east.

Threatened Species: The Proserpine shiner (Figure 8A-4) is a desert fish with a limited geographic range and is threatened primarily by decreased spring flows, habitat loss and alteration of flow regimes. The species only occurs in Texas, and was designated as critically threatened by TPWD in 1977. Terlingua Creek is within the natural habitat of this species. Also possibly located in this area is the threatened species Terlingua Creek cat's eye.

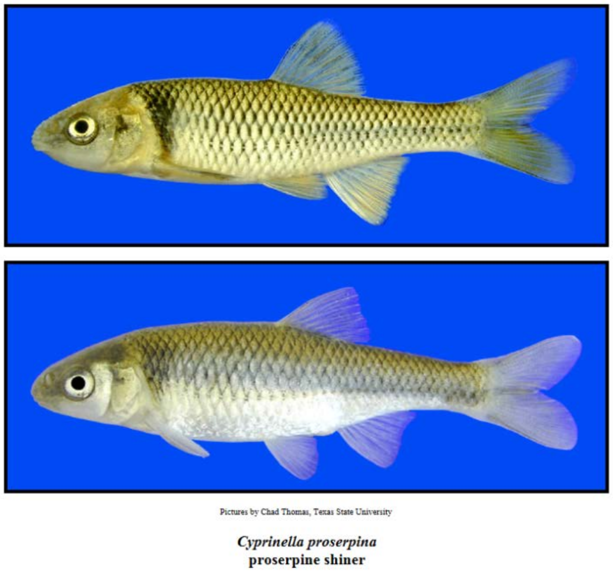


Figure 8A-4. The threatened Proserpine shiner and Terlingua Creek cat's eye.

High Water Quality: The National Park Service has declared Terlingua Creek to have exceptional aesthetic value. The Proserpine shiner can only survive in clear non-turbid waters and are typically associated with spring-fed areas.

<u>Stream Segment endpoints</u>

Terlingua Creek at north BBNP boundary (UTM Zone 13 North):

N 10,609,732, E 2,089,831

Terlingua Creek confluence with Rio Grande (UTM Zone 13 North):

N 10,587,468, E 2,0183,839

<u>References</u>

Bennett, J., and Sirontak, J., 2014. Building Resilience to Drought in Terlingua and Tornillo Creek watersheds through Restoration and Stream Flow Harvesting, 9 p.

Big Bend Natural History Association, 1980. Road Guide to paved and improved dirt roads of Big Bend National Park. Paragon Press. 44 p.

Ragsdale, K.B., Quicksilver Terlingua and the Chisos Mining Company. Texas A&M University Press. 327 p.

TSHA Handbook of Texas Online, 2010. (http://www.tshaonline.org/handbook/online/articles/rbt29), Published by the Texas State Historical Association.

Tyler, R.C., 1996. The Big Bend: A History of the Last Texas Frontier. Texas A&M University Press. 304 p.

CHAPTER 9

WATER INFRASTRUCTURE FINANCING ANAYLSIS

This page intentionally left blank.

9 WATER INFRASTRUCTURE FINANCING ANALYSIS

The Infrastructure Financing Report (IFR) survey presented in this chapter identifies the state financing options proposed by entities in this *Plan* to meet future infrastructure needs. Chapter 5 provides recommended water management strategies for numerous communities in Far West Texas that either have a projected water supply deficit and recommended strategies to meet that need, or have an identified need for a water supply infrastructure project, which may require state financial assistance. These entities were surveyed to determine their proposed method(s) for financing the estimated capital costs involved in implementing the water supply strategies recommended in the *2016 Far West Texas Region Water Plan*.

Unlike infrastructure financing surveys conducted for previous regional water plans, questions during this planning cycle focused on projected needs for financial assistance from programs administered by the TWDB. The TWDB will aggregate the projected requests for funding from these programs from the 16 water planning regions to provide a picture of estimated long-term infrastructure funding needs to the State Legislature.

9.1 TWDB FUNDING PROGRAMS

The TWDB offers financial assistance for the planning, design and construction of projects identified in Regional Water Plans or the State Water Plan. Programs available include the State Water Implementation Fund for Texas (SWIFT), Water Infrastructure Fund (WIF), the State Participation Fund (SP), and the Economically Distressed Areas Program (EDAP). In order to be eligible to apply for funding from any of these sources, the applicant must be a political subdivision of the state, or in some cases a water supply corporation and the proposed project must be a recommended water management strategy in the most recent approved Regional Water Plan or State Water Plan.

9.1.1 State Water Implementation Fund for Texas (SWIFT)

The Texas Legislature created the SWIFT to provide affordable, ongoing state financial assistance for projects in the state water plan. Passed by the Legislature and approved by Texas voters through a constitutional amendment, the SWIFT helps communities develop and optimize water supplies at cost-effective rates. The program provides low-interest loans, extended repayment terms, deferral of loan repayments, and incremental repurchase terms for projects with state ownership aspects. Recognizing the benefit of conservation and the needs of rural Texas, the legislation directed that not less than 10% of the SWIFT funding should support projects for rural communities and agricultural water conservation; and not less than 20% of the funds should support water conservation and reuse projects.

9.1.2 Water Infrastructure Fund (WIF)

The Water Infrastructure Fund (WIF) provides subsidized interest rate loans for planning, design and construction. The WIF-Deferred fund offers the option of deferring all interest and principal payments for up to 10 years for planning, design and permitting costs, while the WIF-Construction fund offers subsidized interest for all construction costs including planning, acquisition, design, and construction.

9.1.3 State Participation Fund (SP)

The State Participation Fund (SP) is geared towards large projects which are regional in scope and meant to capitalize on economies of scale in design and construction, but where the local project sponsors are unable to assume the debt for an optimally sized facility. The TWDB assumes a temporary ownership interest in the project, and the local sponsor repays the cost of the funding through purchase payments on a deferred schedule. The goal of the program is to build a project that will be the right size for future needs, even if that results in the short term in building excess capacity, rather than constructing one or more smaller projects now.

9.1.4 Rural and Economically Distressed Areas (EDAP)

Both grants and zero percent interest loans for planning, design and construction costs are offered through these programs, which are available to eligible small, low-income communities. Rural and economically distressed areas that meet population, income and other criteria are eligible to apply for these funds. EDAP funding eligibility also requires adoption of the Texas Model Subdivision Rules by the applicant planning entities.

9.2 INFRASTRUCTURE FINANCE SURVEY

The survey instrument is prefaced with an explanation of its purpose in identifying the need for financial assistance programs offered by the State of Texas and administered by the TWDB. The available funding programs (SWIFT, WIF, SP and EDAP) are summarized, and the survey participant is asked to: 1) identify the amounts they might request from each funding source for each identified project or strategy; and 2) the earliest date the funds would be needed, by fund type. Water user groups with multiple strategies to meet future water needs are only surveyed for strategies with a capital cost.

All communities listed in Chapter 5, Table 5-2 with water management strategies were presented with surveys provided by the TWDB. The survey along with supporting documentation that summarized the water management strategies included in the *Regional Plan* for that entity were delivered to the mayor or the city/utility manager and follow-up contacts were made with each entity to encourage response to the survey. Table 9-1 presents the surveys responses.

This page intentionally left blank

Table 9-1. Infrastructure Finance Survey

Political Subdivision Name	2016 Strategy ID	Project Name	Total Project Capital Cost	Earliest Year of Need	Planning, Desing Permitting & Acquisition Amount	Construction Funding Amount	Total Anticipated State Funding Amount	% State Participation in Excess Capacity of Project	% of Capital Cost Political Subdivision is Unable to Pay	Options for Unmet Capital Cost
Brewster County Other	E-1	Water loss audit and main-line repair for Brewster County Other (Marathon WSSService)	-	-	-	-	-	-	-	No Survey Received
	E-2	Water loss audit and main-line repair for Brewster County Other (Rio Grande Village BBNP)	-	-	-	-	-	-	-	No Survey Received
	E-3	Water loss audit and main-line repair for Brewster County Other (Panther Junction BBNP Plt)	-	-	-	-	-	-	-	No Survey Received
City of Van Horn	E-4	Water loss audit and main-line repair	-	-	-	-	-	-	-	No Survey Received
Culberson County Mining	E-5	Additional groundwater wells - Rustler Aquifer	-	-	-	-	-	-	-	No Survey Received
	E-6	Additional groundwater well - West Texas Bolsons Aquifer / Upper Salt Basin	-	-	-	-	-	-	-	No Survey Received
Town of Anthony	E-7	Water loss audit and main-line repair	-	-	-	-	-	-	-	No Survey Received
	E-8	Arsenic treatment facility	$8,491,883.00	In Progress	$1,041,936.00	$7,449,947.00	$7,449,947.00	0	$7,449,947.00	Currently funded by DWSRF
	E-9	Additional groundwater well - Hueco Mesilla Bolson Aquifer	$1,244,471.00	2016	$220,000.00	$1,024,471.00	$1,244,471.00	0	$1,244,471.00	TWDB - SWIFT, DWSRF
City of El Paso (EPWU)	E-11	Advanced purified water at the Haskell and NW WWTPs	-	-	-	-	-	-	-	No Survey Received
	E-12	Advanced purified water at the Bustamante WWTP	-	-	-	-	-	-	-	No Survey Received
	E-13	Recharge of Hueco Aquifer groundwater with treated surface water from Jonathan Rogers Plant	-	-	-	-	-	-	-	No Survey Received
	E-14	Treatment & reuse of agricultural drain water	-	-	-	-	-	-	-	No Survey Received
	E-15	Expansion of local well fields	-	-	-	-	-	-	-	No Survey Received
	E-16	Brackish Groundwater at the Jonathan Rogers WTP	-	-	-	-	-	-	-	No Survey Received
	E-17	Expansion of the Kay Bailey Hutchison Desal Plant	-	-	-	-	-	-	-	No Survey Received
	E-18	Groundwater from Hueco Ranch	-	-	-	-	-	-	-	No Survey Received
	E-19	Groundwater from Southern Hudspeth County	-	-	-	-	-	-	-	No Survey Received
	E-20	Expansion of the Jonathan Rogers WTP	-	-	-	-	-	-	-	No Survey Received
	E-21	Riverside Regulating Reservoir	-	-	-	-	-	-	-	No Survey Received
	E-22	Groundwater from Diablo Farms	-	-	-	-	-	-	-	No Survey Received
	E-23	Groundwater from Dell City area	-	-	-	-	-	-	-	No Survey Received
Lower Valley Water District	E-26	Surface water treatment plant & transmission line	-	-	-	-	-	-	-	No Survey Received
	E-27	Groundwater from proposed Well field	-	-	-	-	-	-	-	No Survey Received
	E-28	Groundwater from proposed Well field	-	-	-	-	-	-	-	No Survey Received
	E-29	Wastewater treatment facility and ASR	-	-	-	-	-	-	-	No Survey Received
Horizon Regional MUD	E-35	Additional wells & expansion of desal plant	-	-	-	-	-	-	-	No Survey Received
El Paso County Tornillo WID	E-38	Additional groundwater well & transmission line	-	-	-	-	-	-	-	No Survey Received
	E-39	Arsenic treatment facility	-	-	-	-	-	-	-	No Survey Received
City of Vinton	E-40	High capacity water lines for improved distribution of water from EPWU	$11,973,833.00	2016	$3,000,000.00	$8,973,833.00	$8,381,683.00	0	$11,973,833.00	TWDB, USDA, BECC, EDA
El Paso County Irrigation (EPCWID #1)	E-45	Improvements to water district delivery system	-	-	-	-	-	-	-	No Survey Received

Table 9-1. (Continued) Infrastructure Finance Survey

Political Subdivision Name	2016 Strategy ID	Project Name	Total Project Capital Cost	Earliest Year of Need	Planning, Desing Permitting & Acquisition Amount	Construction Funding Amount	Total Anticipated State Funding Amount	% State Participation in Excess Capacity of Project	% of Capital Cost Political Subdivision is Unable to Pay	Options for Unmet Capital Cost
El Paso County Mining	E-47	Additional groundwater wells - Hueco-Mesilla Bolson Aquifer	-	-	-	-	-	-	-	No Survey Received
Hudspeth County Other (Dell City)	E-49	Water loss audit and main-line repair	-	-	-	-	-	-	-	No Survey Received
	E-50	Brackish groundwater desal facility	-	-	-	-	-	-	-	No Survey Received
Hudspeth County Other (Fort Hancock WCID)	E-51	Water loss audit and main-line repair	-	-	-	-	-	-	-	No Survey Received
	E-52	Additonal well & RO treatment facility	-	-	-	-	-	-	-	No Survey Received
Hudspeth County Other (City of Sierra Blanca-Hudspeth Co. WCID #1)	E-53	Additional transmission line to supply connections outside of the District	-	-	-	-	-	-	-	No Survey Received
Hudspeth Irrigation (HCUWCD #1)	E-54	Additional groundwater wells - Rio Grande Alluvium Aquifer	-	-	-	-	-	-	-	No Survey Received
Hudspeth County Mining	E-57	Additional groundwater well - West Texas Bolsons Aquifer / Eagle Flat	-	-	-	-	-	-	-	No Survey Received
Fort Davis WSC	E-58	Additional groundwater well - Igenous Aquifer	-	-	-	-	-	-	-	No Survey Received
	E-59	Additional transmission line to connect Fort Davis WSC to Fort Davis Estates	-	-	-	-	-	-	-	No Survey Received
Jeff Davis County Other (Town of Valentine)	E-60	Additional groundwater well - West Texas Bolsons Aquifer / Salt Basin	-	-	-	-	-	-	-	No Survey Received
City of Marfa	E-61	Additional groundwater well - Igneous Aquifer	-	-	-	-	-	-	-	No Survey Received
City of Presidio	E-62	Water loss audit and main-line repair	-	-	-	-	-	-	-	No Survey Received
	E-63	Additional groundwater well - West Texas Bolsons Aquifer / Presidio-Redford	-	-	-	-	-	-	-	No Survey Received

CHAPTER 10

PUBLIC PARTICIPATION AND PLAN ADOPTION

This page intentionally left blank.

10 PUBLIC PARTICIPATION AND PLAN ADOPTION

The Far West Texas Water Planning Group (FWTWPG) members recognized from the beginning the importance of involving the public in the planning process. Chapter 10 contains an overview of the FWTWPG representation, the Group's commitment to public involvement, and 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 responses to comments on the Initially Prepared Plan by the Public (Appendix 10A), TWDB (Appendix 10B), and TPWD (Appendix 10C).

10.1 REGIONAL WATER PLANNING GROUP

The TWDB initially appointed a coordinating body for Far West Texas, based on names submitted by the public for consideration. The FWTWPG has since expanded its membership based on familiarity with persons who could appropriately represent a water user group. Senate Bill 1 provisions mandate that one or more representatives of the following water user groups be seated on each water planning group: agriculture, counties, electric generating utilities, environment, industries, municipalities, river authorities, public, small business, water districts, and water utilities. Because there is no river authority in Far West Texas, this sector is not represented. New to this planning period, additional voting members have been appointed to represent Groundwater Management Areas

In addition to these required interest groups, the FWTWPG added the following: travel and tourism, groundwater conservation districts, building and real estate, economic development, Fort Bliss Garrison Command and legislative representatives. The voting members of the FWTWPG are only compensated for allowable travel expenses and have voluntarily devoted considerable amounts of their time and talent to develop the regional water plan. Current Planning Group members and their alternates are listed in Table 10-1.

Table 10-1. Current Group Members and Their Alternates

Water Use Category	Committee Member	County	Alternate Member	County
Agriculture	Tom Beard	Brewster	Conrad Arriola	Brewster
Agriculture	Rick Tate	Presidio		
Building / Real Est.	David Etzold	El Paso	Ray Adauto	El Paso
Counties	Teresa Todd	Jeff Davis	Val Beard	Brewster
Counties	Vacant			
Counties	Vincent Perez	El Paso	Jose Landeros	El Paso
Economic Develop.	Paige Waggoner	El Paso	Thalia Badillo	El Paso
Environment	Jeff Bennett	El Paso	Kevin Urbanczyk	El Paso
Elec. Generating Util.	Roger Chacon	El Paso	William P. Patton	El Paso
GMA#4	Summer Webb	Culberson		
Groundwater Dist.	Randy Barker	Hudspeth	Talley Davis	Hudspeth
Groundwater Dist.	Janet Adams	Jeff Davis		
Industries	Leslie Ann Allen	El Paso	Allen Hains/Paul Perez	El Paso
Municipalities	Becky Brewster	Culberson		
Municipalities	Scott Reinert	El Paso	John Belliew	El Paso
Municipalities	Sylvia Borunda Firth	El Paso	Chelsea Brown	El Paso
Public	Arlina Palacios	El Paso		
Public	Dave Hall	El Paso	Darryl S. Vereen	El Paso
Public	Sterry Butcher	Presidio	Patt Sims	Presidio
Small Business	Mike Livingston	Presidio		
Travel/Tourism	Mike Davidson	Brewster	David Crum	Jeff Davis
Water Districts	Jim Ed Miller	Hudspeth	Bill Skov	El Paso
Water Districts	Chuy Reyes	El Paso	Johnny Stubbs	El Paso
Water Utilities	Albert Miller	Jeff Davis	Scott Adams	Jeff Davis

In addition to the FWTWPG members, 13 non-voting members are appointed. Their function is to provide advice and guidance, based on their respective areas of expertise or geographic areas. Two non-voting liaisons were assigned from Regions F and J adjacent to Far West Texas. The non-voting members and their alternates are listed in Table 10-2.

Table 10-2. Non-Voting Members and Their Alternates

Non-Voting Member	Agency/Organization	Alternate Member	Agency
Raymond Bader	Texas Ag. Ext. Service		
Filiberto Cortez	USBR	Woody Irving/Mike Landis	USBR
Michael Lemonds	GLO		
William Finn	IBWC	Clifford Regensberg	IBWC
Hector Garza	USGS	Ann Ardis	USGS
Ron Glover	Hunt NR, Ltd.		
Otila Gonzalez	Region J		
Ari Michelsen	TX AgriLife Research	Zhuping Sheng	
Enrique Munoz	CILA Mexico	Aldo Garcia	CILA Mexico
Caroline Runge	Region F		
Russell Martin	TPWD	Philip Dickerson	TPWD
Thomas Barnett	TWDB		
Alfredo Riera	Public Works		

10.2 PROJECT MANAGEMENT

During the first planning cycle, work on the *Far West Texas Water Plan* was divided along two parallel tracks; (1) an urban track representing the metropolitan portion of El Paso County, and (2) a rural track representing the other six rural counties and the eastern portion of El Paso County. Work developed along the two-track approach was integrated at appropriate intervals to ensure a unified, coherent regional plan. During subsequent planning cycle, this approach was augmented, and the entire FWTWPG worked together on the *Regional Plan* from start to finish. However, the two tracks are still considered to insure that voting membership is equally represented.

The planning decisions and recommendations made in the *Far West Texas Water Plan* will have far-reaching and long-lasting social, economic, and political repercussions on each community involved in this planning effort and on individuals throughout the Region. Therefore, involvement of the public is a key factor for the success and acceptance of the *Plan*. Open discussion and citizen input is encouraged throughout the planning process and helps planners develop a *Plan* that reflects community values and concerns. Some members of the public participate almost as non-voting members.

To insure public involvement, notice of all Planning Group and subcommittee meetings was posted in advance, mailed to a list of over 200 interested parties including mayors, county judges, water rights holders, public school superintendents, water districts, and concerned citizens; and e-mailed to an additional 350 interested parties. All meetings were held in publicly accessible locations with sites rotating among rural and urban locations throughout the counties in the Region. Special public meetings were held to gather input on the development of specific aspect of the *Plan*. Prior to submittal of the *Initially Prepared Plan* to the TWDB, a copy of the *Draft 2016 Far West Texas Water Plan* was provided for inspection in the county clerk's office and in at least one library in each county, and online on the Rio Grande COG website. Following public inspection of the Initially Prepared Plan, one public meeting was conducted to present results of the planning process and gather public input and comments.

To provide a public access point, an internet web site www.riocog.gov 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 FWTWPG 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 meetings of the FWTWPG, including committee meetings, were open to the public and visitors were encouraged to express their opinions and concerns, or to make suggestions regarding the planning process. The locations of the meetings were originally rotated between all seven counties so that all citizens within the region would have an equal opportunity to attend. However, because of increased public attendance, the meetings were held predominantly in Alpine and Clint, where adequate facilities could be arranged.

In accordance with the State Open Meetings Act, meeting notices were posted in the following newspapers and were reported by the following radio stations:

- El Paso Inc.
- West Texas County Courier
- Hudspeth County Herald
- Van Horn Advocate
- Alpine Avalanche
- Jeff Davis County News/Mountain Dispatch
- Presidio International
- Big Bend Sentinel
- Terrell County News Leader
- KALP FM (Alpine)
- KVLF AM (Alpine)

A final public hearing was held in El Paso on June 30, 2015 to receive comments on the *Initially Prepared Plan*. Responses to all public, TWDB and TPWD comments are included in this chapter as Appendix 10A, Appendix 10B and Appendix 10C.

Copies of the *Initially Prepared Plan* were available at the following locations:

County Clerk's Office:

- Brewster County
- Culberson County
- El Paso County
- Hudspeth County
- Jeff Davis County
- Presidio County
- Terrell County

Public Libraries:

- Alpine Public Library, 203 N. 7th St., Alpine
- Marathon Public Library, 106 N. 3rd, Marathon
- Big Bend High School Library, 550 Roadrunner, Terlingua
- Van Horn City-County Library, 410 Crockett St., Van Horn
- El Paso Public Library, 501 N. Oregon, El Paso
- Law Library, El Paso County Courthouse, 500 E. San Antonio
- Clint ISD/Public Library, 12625 Alameda, Clint
- Grace Grebing Public Library, 110 N. Main, Dell City
- Ft. Hancock ISD/Public Library, 101 School Drive, Ft. Hancock
- Jeff Davis County Library, 100 Memorial Square, Ft. Davis
- Marfa Public Library, 115 E. Oak, Marfa
- City of Presidio Library, 2440 O'Reilly St., Presidio
- Valentine Public Library, Valentine
- Terrell County Public Library, 105 E. Hackberry, Sanderson

The final *2016 Far West Texas Water Plan* was adopted by the FWTWPG on November 5, 2015, the *Plan* was delivered to the TWDB by December 1, 2015, and is posted on the Planning Groups (Rio Grande Council of Governments) website: http://www.riocog.org/ENVSVCS/FWTWPG/docs.htm .

10.4 COORDINATION WITH OTHER REGIONS

The FWTWPG has exchanged liaisons with adjoining Region F and the Plateau Region (Region J). The responsibility of the liaisons is to report on any issues of common interest between adjoining regions. The FWTWPG also coordinated with Region F on groundwater supplies in Jeff Davis County that were exported to Reeves County for municipal use.

10.5 PLAN IMPLEMENTATION

Following final adoption of the *2016 Far West Texas Water Plan*, copies of the *Plan* were provided to each municipality and county commissioner's court in the Region. Early in the next planning cycle, each city will be asked to review the *Plan* and to recommend needed improvements. Each community will also be asked to consider their specific short-range and long-range goals with those presented in the *Plan*. Based on the results of this input, the FWTWPG members may consider plan amendments prior to the conclusion of the next planning period.

APPENDIX 10A
RESPONSE TO PUBLIC COMMENTS

This page intentionally left blank.

RESPONSE TO PUBLIC COMMENTS

1. Arlina Palacios stated that she wanted her presence to be known and that she is here to learn about the process.

- **Acknowledged.**

2. Chuy Reyes of EPCWID stated that affluent water is obligated with EPCWID and EPWU through their 2001 contract. The majority of water is obligated to EPCWID and to the Rio Bosque. Mr. Reyes also stated that they presented a proposal to EPWU on a facility that can capture stormwater. It was proposed at being a little less than $94 million. He said he could share more detail with anyone who would ask.

- **This information is in agreement with EPCWID data in the final *2016 Plan*.**

3. Scott Reinert stated that he believes that the planning process is getting better and sharper each time. He also likes the 5 year timeline.

- **Acknowledged.**

4. Teresa Todd expressed her concern about the Hudspeth County water import strategy/strategies, particularly on adjoining landowners, springs, wildlife, and the aquifer. She said she thought it was very early for a strategy that had not yet been studied to be included in our regional water plan.

- **Regional water planning consultants are modeling the strategy to evaluate potential impacts to adjoining properties.**

5. Ms. Todd brought up the fact that there was a nuclear waste facility proposed in Culberson County near Kent, and asked John Ashworth what, if any, impact(s) this could have on El Paso's proposed water import strategy/strategies from Hudspeth County. In particular she was interested in whether the different sites shared the same aquifer.

- **The potential site of the nuclear waste facility was found to be far distant from and would have no impact on proposed strategies.**

6. Commissioner Jim Ed Miller stated that the proposed EPWU strategy wells in the Diablo Aquifer did not belong to Hudspeth County, that they would be located on State of Texas land.

- **Acknowledged.**

5. Mr. Reinert stated that he wanted to clarify that the EPWU wells would be on GLO leased land.

- **Acknowledged.**

This page intentionally left blank.

APPENDIX 10B
RESPONSE TO TWDB COMMENTS

This page intentionally left blank

TWDB Comments on the Initially Prepared 2016 Far West Texas (Region E) Regional Water Plan

Level 1:	**Comments and questions must be satisfactorily addressed in order to meet statutory, agency rule, and/or contract requirements.**

1. Please consider including a general statement clarifying whether or not the planning group met all requirements under the Texas Open Meetings Act in the final, adopted regional water plan. *[31 TAC §357.21 and §357.50(d)]*

    - **A statement pertaining to meeting the requirements under the Texas Open Meetings Act is added to the 3rd paragraph of Chapter 1 Section 1.1.1.**

2. Page ES-21: The Recommended WMS Roll-Up Summary table included in the Executive Summary (Table ES-7) appears to be missing strategy supply volume information for two strategies (Strategies E-28 and E-53). Please provide complete information in the final, adopted regional water plan.

    - **Revised Table ES-7 WMS Roll-Up Summary has been inserted into the final Plan.**

3. Please describe how publicly available plans of major agricultural, municipal, manufacturing and commercial water users were considered in the final, adopted regional water plan. *[31 Texas Administrative Code (TAC) §357.22(a)(4)]*

    - **A statement pertaining to consideration of publicly available plans is added to the 2nd paragraph of Chapter 1 Section 1.1.1.**

4. Sections 1.2.7 and 1.2.8 include general discussion of agricultural and natural resources and a general discussion of problems related to decreases in water quantity, but do not appear to include a discussion of identified threats to agricultural and natural resources due to water quantity problems. Please include a discussion of any identified threats in the final, adopted regional water plan. *[31 TAC §357.30(7)]*

    - **Additional discussion pertaining to threats to agriculture is added as a last paragraph in Chapter 1 Section 1.2.8.**

5. Please include a summary of the the municipal demand savings due to plumbing fixture requirements (as previously provided by TWDB) in the final, adopted regional water plan. *[31 TAC §357.31(d)]*

    - **A summary of the the municipal demand savings due to plumbing fixture requirements is added to Chapter 2 Section 2.2.2 as Table 2-5.**

6. Page 2-18: Table 2-3 presents information on wholesale water provider (WWP) demands but does not include demand projections over the planning horizon for each water use category and by county. For example, there is no information presented for the irrigation demands for

EPCWID#1. Please include WWP demands by category of use and county in the final, adopted regional water plan. *[31 TAC §357.31(b)]*

- **Chapter 2 Table 2-3 is updated as required.**

7. Page 2-18, Table 2-3: It is not clear whether the plan presents contractual obligations of water user groups (WUGs) and WWPs. Please confirm that the plan includes the current contractual obligations of WUG and WWPs in addition to any demands projected for the WUG and WWP in the final, adopted regional water plan. *[31 TAC §357.31(c)]*

    - **Recognition and protection of existing water rights, water contracts, and option agreements is stated in the 2nd paragraph of Chapter 1Section 1.1.1. This statement is also added to the first paragraph in Chapter 5 Section 5.2.1.**

8. Please provide a statement regarding any water availability requirements promulgated by a county commissioners court pursuant to Texas Water Code (TWC) §35.019, which in Region E applies to the El Paso County Priority Groundwater Management Area. *[31 TAC §357.22(a)(6)]*

    - **A statement pertaining to no promulgation made by the El Paso County Commissioner's Court is added at the end of Chapter 1 Section 1.1.7 and 4th bullet of Chapter 3 Section 3.**

9. Pages 3-26 and 5A-18: The plan states that the Diablo Plateau has "largely unknown" hydrostratigraphy and hydraulic parameters and no methodology is presented on how the availability of the source was determined. However, Strategy E-16, which states that "details of this strategy are still in development" recommends a strategy supply of 10,000 AFY. Please confirm that the source availability for the recommended strategy is available under drought of record conditions and that technical evaluations of water management strategies have complete necessary information in the final, adopted regional water plan. *[31 TAC §357.32(a)(1), §357.34(b)]*

    - **The supply availability calculation for the Diablo Plateau Aquifer is updated in Chapter 3 Section 3.3.10.**

10. Page 3-3, Table 3-1: It is not clear whether the plan utilizes the most current Texas Commission on Environmental Quality (TCEQ) WAM Run 3 for the firm diversion water availability analysis of the Rio Grande Run-of-River diversions. If the most current TCEQ WAM was utilized, please clarify in the final, adopted regional water plan. If not, please present the firm yield using the most current TCEQ WAM in the final, adopted regional water plan. *[31 TAC §357.32(c)]*

    - **The use of the Rio Grande WAM Run 3 is stated in the first bullet under Chapter 3 Section 3.**

11. Page 3-4, Table 3-2: The plan does not appear to report existing supplies for WWPs. Please include existing water supplies for each WWP in the final, adopted regional water plan. *[31 TAC §357.32(e)]*

- **Chapter 3 Table 3-3 has been added following Table 3-2.**

12. The plan does not appear to include a listing of the water rights that are the basis for the surface water availability in the plan. Please include such a listing in the final, adopted regional water plan. *[Contract Exhibit 'C', Section 3.1 and 3.3]*

    - **Water rights have been added to Chapter 3 as Appendix 3A.**

13. The plan does not appear to tabulate the existing local supplies used in the plan, along with an explanation of the basis of the associated local supply water volumes. Please include the required information on local supplies in the final, adopted regional water plan. *[Contract Exhibit 'C', Section 3.3]*

    - **Chapter 3 Section 3.4 Local Supply has been added.**

14. Please clarify how the run-of-river availabilities were calculated for municipal water users to ensure that all monthly demands are fully met for the entire simulation of the unmodified TCEQ WAM Run 3 in the final, adopted regional water plan. *[Contract Exhibit 'C', Section 3.4]*

    - **Municipal run-of-river availability explanation is added to first bullet in Chapter 3 Section 3.**

15. The plan appears to combine reporting of needs for WUGs and WWPs making it unclear if WWP and customer WUG needs are being double-counted in the table totals included in Chapter 4. Please clarify, for example, by including a separate table of water needs for WWPs, by category of use, in the final, adopted regional water plan. *[31 TAC §357.33(b)]*

    - **Table 4-2 Wholesale Water Provider Needs/Surplus is added to Chapter 4**.

16. Page 5-5, Table 5-1: The plan does not appear to identify potentially feasible water management strategies for certain WUGs with identified needs. For example, "no feasible strategy" is noted for HCCRD #1, which is a WUG with a need. Please include documentation that all water management strategy types required by statute and rule, were considered for all identified needs in the final, adopted regional water plan. *[TWC §16.053(e)(5), 31 TAC §357.34(a)]*

    - **Table 5-2 and Appendix 5A now provide strategies for all WUGs with needs. However, insufficient supplies to meet the total needs of two WUGs (El Paso and Hudspeth County Irrigation) are discussed in Chapter 5 Section 5.2.5.**

17. Table 5-2 and pages ES-10 and 5-20: Some conservation water management strategies for municipal WUGs appear to be combined with reuse strategies. For example, strategies for EPCWID #1 and HCUWCD #1 are identified as “Tailwater Reuse – Conservation.” Additionally, the plan defines reuse as conservation on pages ES-10 and 5-20. Unless the projects are directly interdependent, and reflected as such in DB17, each project and strategy must be associated with volumes of water provided by a single strategy type and should not

be lumped together with other types of strategies. Strategy types must remain independent of one another for purposes of accounting water availability, to reflect implementation, and to facilitate project prioritizations for funding. Please revise as appropriate throughout the final, adopted regional water plan and in the regional water planning database. *[31 TAC §357.34(e); Contract Exhibit 'D', Section 5.3]*

- **The first sentence on page ES-10 is subdivided into two sentences so that reuse is not a part of the conservation definition. On page 5-20 the "Reuse of treated wastewater" bullet is eliminated.**

18. Table 5-3: The plan does not appear to include a unit cost for Strategy E-53. Please include unit costs for all strategies in the final, adopted regional water plan. *[Contract Exhibit 'C', Section 5.1.2]*

    - **Unit costs for all strategies are now included in Table 5-3.**

19. The plan in some instances, does not appear to include a quantitative reporting of environmental factors. For example, strategy evaluations E-35, E-36, E-37, E-42, E-44, E-45, E-46, E-47, E-48, and E-53 do not appear to include quantified environmental factors, even if there is no impact. Additionally, Tables 5-2 and 5-4 present qualitative numeric scores but it is unclear if the scores are based upon quantitative data. Please include quantitative reporting in the final, adopted regional water plan. *[31 TAC §357.34(d)(3)(B)]*

    - **Qualitative and quantitative ranges for applicable columns in Tables 5-2 and 5-4 are now provided in Appendix 5B.**

20. Appendix 5A: The plan in some instances, does not appear to include a quantitative reporting of impacts to agricultural resources. For example, strategy evaluations E-35, E-36, E-37, E-42, E-44, E-45, E-46, E-47, E-48, and E-53 do not appear to include quantified impacts to agricultural resources, even if there is no impact. Additionally, Table 5-2 presents a qualitative numeric scores but it is unclear if the scale is based upon quantitative data. Please include quantitative reporting in the final, adopted regional water plan. *[31 TAC §357.34(d)(3)(C)]*

    - **Qualitative and quantitative ranges for applicable columns in Tables 5-2 and 5-4 are now provided in Appendix 5B.**

21. Appendix 5A: From the information presented in the plan, it is not clear that all required capital cost components were evaluated for each strategy. Additionally, it is not clear whether the Unified Costing Model was utilized for cost estimates or if other project-specific methodologies were utilized. Please clarify the costing methodology (e.g., data sources) utilized for any water management strategy cost estimates that were not produced using the Unified Costing Model and include the cost output, for example from the Unified Costing Model, as an Appendix, in the final, adopted regional water plan. *[31 TAC §357.34(d)(3)(A), Contract Exhibit 'C', Sections 5.1.2 and 5.1.2.1]*

    - **A statement about the use of the Unified Costing Tool and other cost estimating procedures is provided in Chapter 5 Section 5.2.1.**

22. Page 5-5, Table 5-1: The plan does not appear to consider conservation or drought management as a potentially feasible strategy for all identified water supply needs. Please include documentation that conservation and drought management water management strategy types were considered, as required, to meet identified needs and, if not recommended, please document the reason in the final, adopted regional water plan. *[31 TAC §357.34(f)]*

    - **Table 5-2 provides a listing of conservation strategies developed for all WUGs with needs. First paragraph of Chapter 5 section 5.2.2 provides a discussion pertaining to consideration of conservation and drought management plans.**

23. Page 5-19: The plan does not appear to include a copy of the model water conservation plans and the referenced online links to the model plans do not appear to link to the referenced documents at the time of plan review. Please ensure operational links to the model conservation plans if they are to be included only by online reference. *[31 TAC §357.34(g)]*

    - **A paragraph and link are added to Chapter 5 Section 5.3.1.2.**

24. Page 5A-20: It is not clear whether the firm yield of the surface water component of the Riverside Regulating Reservoir was evaluated using the most current TCEQ WAM Run 3. Please clarify whether analyses were based upon TCEQ WAM Run 3 in the final, adopted regional water plan. If not based upon TCEQ WAM Run 3, please present results using the most current TCEQ WAM Run 3 in the final, adopted regional water plan. *[31 TAC §357.34(d)(1)]*

    - **The Riverside Regulating Reservoir is not a firm yield reservoir project – it provides storage to improve the efficiency of water use. The reservoir will temporarily store water after it has already been diverted from the Rio Grande into the canal system. Water that is not used immediately by the irrigation district or EPWU can be stored there for later use. It is anticipated that the reservoir will be filled and emptied multiple times during the irrigation season. As stated in the project description, the reliability of the supply depends on available river supplies and the availability of unneeded water in the canal. Although by itself the supply from this strategy may not be fully reliable, as part of the Integrated Water Management Strategy a reliable supply will be made available through conjunctive use of this supply with water from other sources available to EPWU and EPCWID#1. WAM Run 3 is not an appropriate tool to analyze this project. The WAM shows a theoretical month-by-month availability from the Rio Grande project and local runoff, but it does not include modeling of the delivery and use of the water from the canal system. The supplies available from this project are based on an evaluation by EPCWID and others of the historical water diverted into the canal system that was not used and returned to the river. The WAM does not include information regarding how the water is used once it is diverted from the river; it simply assumes that all of the water is used.**

25. The plan does not indicate whether there would be any unmet needs remaining after water management strategies have been implemented. Please include a summary of unmet needs, if

any, in the final, adopted regional water plan. If no unmet needs exist, please include a statement to that effect. *[31 TAC §357.35(d)]*

- **Section 5.2.5 has been added to Chapter 5 that discusses the two WUGs (El Paso and Hudspeth County Irrigation) that have remaining unmet needs.**

26. The plan in some instances, does not include a description of the impacts of recommended water management strategies on key water quality parameters. For example, strategy evaluations E-35, E-36, E-37, E-42, E-44, E-45, E-46, E-47, E-48, and E-53 do not include water quality information. Please include a description of these impacts, including if negligable, in the final, adopted regional water plan. *[31 TAC §357.40(b)(5)]*

    - **A column in Table 5-2 provides a range value for water quality impacts. Appendix 5B provides a quantifiable description of the quality range.**

27. Page 6-4, Section 6.3: The plan states that a quantitative analysis of the plan impacts on recommended or designated stream segments has been conducted but does not present the results. Please include the quantitative analysis in the final, adopted regional water plan. *[31 TAC §357.43(b)(2)]*

    - **A column in Table 5-2 provides an impact range value for designated stream segments. Appendix 5B provides a quantifiable description of the stream segment impact range.**

28. Please indicate how the planning group considered relevant recommendations from the Drought Preparedness Council (a letter was provided to planning groups with relevant recommendations in November 2014) in the final, adopted regional water plan. [*31 TAC §357.42(h)]*

    - **Drought Preparedness Council recommendations are recognized in Chapter 1 Section 1.1.1, discussed in more detail in Chapter 5 Section 5.2.1, and a link to the site is provided in Chapter 7 Section 7.1.**

29. Section 7.6.3: The plan contains region-specific data for use in a model drought contingency plan but does not appear to include region-specific model drought contingency plans. Please provide these model plans in the final, adopted regional water plan, for example in an Appendix or as an active link to an electronic document. *[31 TAC §357.42(j)]*

    - **A paragraph and link are added to Chapter 7 Section 7.6.4.1**

30. Please clarify in the final, adopted regional water plan how the plan development was guided by the principal that the designated water quality and related water uses as shown in the State Water Quality Management Plan shall be improved or maintained. *[31 TAC §358.3(19)]*

    - **Paragraphs describing this guiding principal are added in Chapter 5 Section 5.2.1.**

31. Please clearly summarize which, if any, recommended water management strategies rely on or mutually exclude another recommended strategy. If such relationships exist, please describe how the strategy interactions impact the estimated water availability and yield associated with each impacted water management strategy in the final, adopted regional water plan. *[31 TAC §357.34(d)(3)(A), Contract Exhibit 'C', Section 3.4.2]*

    - **Mutually associated strategies are described in a new paragraph in Chapter 5 Section 5.2.1.**

32. Page 5A-20, Strategy E-18: The plan does not appear to present separately the reservoir-associated land costs. Please include reservoir-associated land costs, separately, in the final, adopted regional water plan. *[Contract Exhibit 'C', Section 5.1.2]*

    - **This strategy is now Strategy E-21. EPWU already owns the site of the Riverside Regulating Reservoir, so it was not included in the cost estimate. No land cost.**

33. The technical evaluations of the water management strategies do not appear to estimate water losses from the associated strategies. Please include an estimate of water losses in the final, adopted regional water plan, for example as an estimated percent loss. *[31 TAC §357.34(d)(3)(A); Contract Exhibit 'C', Section 5.1.1]*

    - **An estimated percent strategy supply loss is stated in the first paragraph of Chapter 5 Section 5.2.1.**

34. Please submit all required electronic files with the final, adopted regional water plan. *[Contract Exhibit 'C', Section 12.2.1; Contract Exhibit 'D', Section 2.1]*

    - **All required electronic files are submitted along with the adopted Far West Texas Water Plan.**

Level 2: Comments and suggestions for consideration that may improve the readability and overall understanding of the regional water plan.

1. Chapter 3: Please consider providing a more complete description of the groundwater availability methodology employed for non-relevant aquifer groundwater sources in the plan including Hueco-Mesilla Bolsons and Rio Grande Alluvium in El Paso and Hudspeth counties.

    - **Availability methodology for the Hueco Bolson, Rio Grande Alluvium, and Diablo Plateau Aquifers are no presented in Chapter 3.**

2. Page 3-29: Table 3-3 reflects "XXX" for the City of Alpine pumping from the Muzquiz field. Please provide this information in the final, adopted regional water plan.

    - **Chapter 3 Table 3-4 is updated with 2014 information.**

3. Table 4-1: Please consider including a footnote indicating that "( )" indicates an identified water need in the final, adopted regional water plan.

    - **Footnote is added to bottom of Table 4-1.**

4. Page 5-19 and 5-20: The plan includes outdated links for TWDB references (".state.tx.us"). Please consider updating the website links to the current address of ".texas.gov" and updating the reference sources from Report 362 prepared by the Water Conservation Implementation Task Force, to the newer version by TWDB and TCEQ in coordination with the Water Conservation Advisory Council, in the final, adopted regional water plan. This current information is available online at http://www.twdb.texas.gov/conservation/BMPs/

    - **TWDB references have been updated in Chapter 5, Section 5.3.1.3 to include the current address of ".texas.gov". In addition, the newer practices guides developed by TWDB and TCEQ in coordination with the Water Conservation Advisory Council has been referenced and the current hyperlink has been provided (http://www.twdb.texas.gov/conservation/BMPs/).**

5. Page 6-3, Section 6.2: The text appears to include socioeconomic information from the 2011 plan. Please cite the source of this data and/or update it with the socioeconomic data provided by TWDB in the final, adopted regional water plan.

    - **Chapter 6 Section 6.2 is updated to show 2016 socioeconomic information.**

6. Please consider including all the potential emergency interconnects noted in Table 7-4 in the list of potential emergency interconnects in Table 7-2 in the final, adopted regional water plan, if appropriate.

    - **Table 7-2 has been updated to include the entities listed in Table 7-4.**

7. Page 7-45 and 7-46: Please consider completing the recommended drought triggers and actions for the entities included in Table 7-9, or explaining why no information was available for certain entities, in the final, adopted regional water plan.

- **Table 7-9 has been updated and is complete for all listed entities. Entities in the table where limited information was provided, has been indicated with either N/A or "no recommendations".**

8. Appendix 8A: The plan includes one new unique stream segment recommended by the planning group for designation (Terlingua Creek within boundaries of Big Bend National Park). Please include the status of submittal of the package to the Texas Parks and Wildlife Department (TPWD), and if availble, TPWD's response to the reqest in the final, adopted regional water plan.

This page intentionally left blank.

.

APPENDIX 10C
RESPONSE TO TPWD COMMENTS

This page intentionally left blank

September 11, 2015

Mr. Tom Beard, Chair
Far West Regional Water Planning Group
Rio Grande Council of Governments
8037 Lockheed
El Paso, Texas 79925

Re: 2016 Far West Texas Region E Initially Prepared Plan

Dear Mr. Beard:

Thank you for seeking review and comment from the Texas Parks and Wildlife Department (TPWD) on the 2016 Initially Prepared Regional Water Plan (IPP) for the Far West Texas Region E Water Planning Area. As you know, water impacts every aspect of TPWD's mission to manage and conserve the natural and cultural resources of Texas. As the agency charged with primary responsibility for protecting the state's fish and wildlife resources, TPWD is positioned to provide technical assistance during the water planning process. Although TPWD has limited regulatory authority over the use of state waters, TPWD is committed to working with stakeholders and others to provide science-based information during the water planning process intended to avoid or minimize impacts to state fish and wildlife resources.

TPWD understands that regional water planning groups are guided by 31 TAC §357 when preparing regional water plans. These water planning rules spell out requirements related to natural resource and environmental protection. Accordingly, TPWD staff reviewed the IPP with a focus on the following questions:

- Does the IPP include a quantitative reporting of environmental factors including the effects on environmental water needs and habitat?
- Does the IPP include a description of natural resources and threats to natural resources due to water quantity or quality problems?
- Does the IPP discuss how these threats will be addressed?
- Does the IPP describe how it is consistent with long-term protection of natural resources?
- Does the IPP include water conservation as a water management strategy?
- Does the IPP include Drought Contingency Plans?
- Does the IPP recommend any stream segments be nominated as ecologically unique?
- If the IPP includes strategies identified in the 2010 regional water plan, does it address concerns raised by TPWD in connection with the 2010 Water Plan.

4200 SMITH SCHOOL ROAD
AUSTIN, TEXAS 78744-3291
512.389.4800
www.tpwd.texas.gov

The population of the 7 county Far West Texas Water Planning Region is estimated to grow from about 954,035 in 2020 to about 1.55 million by 2070. Seventy-seven percent of the 2020 population is expected to live in the City of El Paso. Water needs are expected to grow from 645,404 acre-feet per year in 2020 to 693,597 acre-feet per year by 2070. Seventy-three percent of water use in the Region is by the agricultural sector in support of irrigation. Recommended Water Management Strategies (WMS) for meeting future water needs include municipal and agricultural conservation, reuse, reallocation of existing supplies, additional groundwater development including brackish groundwater, and expansion of the Kay Bailey Hutchinson Desalination Plant. TPWD supports the inclusion of an aquifer storage and recovery project. Aquifer storage and recovery projects are generally preferred over surface reservoirs since habitat impacts can be minimized. TPWD supports the planning group's consideration of brush control/management as an additional means of conserving water if done in a manner that can also benefit wildlife habitat.

The Far West Texas IPP includes descriptions of natural resources and acknowledges the importance of protecting those resources. Environmental and recreational water needs are discussed in Chapter 2. It would be appropriate to mention the Senate Bill 3 environmental flows process in this discussion. Table 5-4 provides a comparative analysis of environmental impacts related to each WMS. Quantitative reporting of environmental impacts is somewhat limited since recommended strategies rely largely on water conservation, reuse, reallocation, conjunctive use of surface and groundwater supplies, and groundwater sources.

The IPP includes a good discussion of the region's major springs and seeps that occur on state, federal, or privately owned conservation properties. According to the IPP, groundwater availability was assessed with the goal of not significantly lowering groundwater levels in order to maintain spring flows and groundwater-surface interaction. Maintenance of springs and surface flows is key for protecting aquatic ecosystems that depend on these features. Where possible, potential impacts to spring flows and spring ecosystems should be quantified where continued groundwater use, additional groundwater development, and groundwater exportation are identified as water management strategies. TPWD concurs that deep well injection disposal of brine concentrate resulting from brackish groundwater desalination is one preferred approach to minimize impacts to fish and wildlife resources.

The IPP generally states that environmental impacts from additional groundwater development is expected to be low, but does not provide quantitative analysis supporting this statement. Additional research is recommended to determine the sustainable level of utilization of these aquifers that avoids negative indirect impacts to the Diamond Y and other groundwater-fed springs. Boghici (1997) [i]determined that the Rustler Aquifer is the chief source of flow at Diamond Y Springs. Drawdown of this aquifer could reduce flows at Diamond Y Springs, which provides critically important habitat for two species of rare desert fishes listed as federally endangered species (the Leon Springs pupfish, *Cyprinodon bovinus* and the Pecos Gambusia, *Gambusia nobilis*), the federally threatened, rare, salt-tolerant Pecos (or puzzle) sunflower, four other globally rare plants and a suite of rare aquatic invertebrates.

Chapter 8 of the IPP identifies the Davis Mountains Igneous Aquifer and Edwards-Trinity (Plateau) Aquifer as groundwater sources for springs feeding into multiple Ecologically Unique Stream Segments including the Cienega (Chinati Mountains State Natural Area), Alamito and Cienega Creeks (Big Bend Ranch State Park), Alamito Creek (Trans-Pecos Water Trust), Independence Creek (TNC – Independence Creek Preserve), and Madera, Limpia, Little Aguja, and Upper Cherry Creeks (TNC – Davis Mountains Preserve), but states "no strategies use this aquifer as their source supply"; however, several strategies in Chapter 5 rely on the Davis Mountains Igneous Aquifer and the Edwards-Trinity (Plateau) Aquifer. Please clarify this discrepancy.

TPWD commends the Far West Texas Water Planning Group strong emphasis on water conservation and reuse. According to the IPP, El Paso Water Utility's (EPWU) water conservation efforts have reduced per capita municipal use in El Paso from about 225 gallons per capita per day (gpcd) in the late 1970s to a current level of 132 gpcd. The overall per capita potable water use for EPWU and its wholesale customers, including steam electric and industrial use, was about 130 gpcd in 2013, bringing it under the Texas Water Conservation Task Force goal of 140 gallons per capita per day. Water management and drought contingency plans for regional entities are discussed in detail in the IPP.

The EPWU and The El Paso County Water Improvement District No. 1 propose to build a regulating reservoir adjacent to local water treatment plants to store "excess" water that would otherwise flow into the Rio Grande. Recent research shows that the volume and timing of periodic flood events in the Rio Grande is critical to a suite of ecological processes including cottonwood regeneration, spawning of endemic and endangered fish species, and the redistribution of sediment within the river channel. Regulating flood events by diverting water that would otherwise flow into the Rio Grande will likely exacerbate the deteriorating ecological condition and hydrologic function of the Rio Grande. Currently, a pipeline connecting the water treatment plants to the reservoir will bisect the Rio Bosque Wetlands Park, which may have detrimental impacts to ecological restoration efforts at that site. If this strategy moves forward, it is recommended that the wastewater treatment ponds be modified to function like and modelled after the Rio Bosque wetlands, which will simulate the natural flood "buffer" the project desires while simultaneously filtering the water prior to transporting it to the wastewater treatment facilities. In addition, this approach will provide artificial wildlife habitat to mitigate the ecological and hydrologic impacts of diverting flood waters. It is also recommended that the wastewater treatment ponds be incorporated into and managed by the Rio Bosque Wetlands Park.

TPWD commends the Far West Texas Regional Planning Group for once again nominating as ecologically unique stream segments that were nominated in the 2006 and 2011 Initially Prepared Plans. In addition, the Water Planning Group has added in this 2016 Plan Terlingua Creek in Big Bend National Park to its list of recommended stream segments. TPWD stands ready to provide any additional supporting information necessary to designate these segments as unique.

Please update Table 10-2 by replacing TPWD non-voting member Billy Tarrant with Russell Martin. Philip Dickerson should be listed as the TPWD alternate member.

Thank you for your consideration of these comments. TPWD looks forward to continuing to work with the planning group to develop water supply strategies that not only meet the future water supply needs of the region but also preserve the ecological health of the region's aquatic resources. Please contact Cindy Loeffler at (512) 389-8715 if you have any questions or comments.

Sincerely,

Ross Melinchuk,
Deputy Executive Director, Natural Resources

RM:CL:ms

cc: Clayton Wolf, Division Director, Wildlife Division, TPWD
Russell Martin, Wildlife Division, TPWD
Philip Dickerson, Wildlife Division, TPWD

Reference:
Boghici, Radu. *Hydrogeological investigations at Diamond Y Springs and surrounding area, Pecos County, Texas*. MS thesis. University of Texas at Austin, 1997. http://www.karstportal.org/download/file/fid/347

RESPONSE TO TPWD COMMENTS

The Far West Texas Water Planning Group (FWTWPG) greatly appreciates the assistance that staff of the Texas Parks and Wildlife Department (TPWD) has provided throughout all of the planning periods. The current *IPP* comment letter is quite complimentary and contains a number of justifiable recommendations. It has been a goal of the FWTWPG to recognize the importance of the natural resources and ecological environments of this Region as they play a key role in the healthy economy of this Region. It is hoped that many of TPWD's concerns pertaining to maintaining healthy environmental habitats are addressed in the final *2016 Far West Texas Water Plan*.

The most critical concern voiced in the TPWD comments is the need to better quantify potential impacts to spring flows and spring ecosystems resulting from additional groundwater development and groundwater exportation as identified in certain water management strategies. The final *2016 Plan* does contain a new Appendix 5B, which provides both quantitative and qualitative descriptions of impact ranges. However, the FWTWPG acknowledges that improvement in strategy impact analysis is needed and will strive to do so during the next planning period.

Statements pertaining to strategy impacts on ecologically unique stream segments in Chapter 8 Section 8.2 have been modified to address potential impacts of specific strategies that draw water from the same aquifer as the designated stream segment. The FWTWPG will also further review Chapter 5 discussion on the regulating reservoir water management strategy.

This page intentionally left blank

CHAPTER 11

IMPLEMENTATION AND COMPARISON TO THE PREVIOUS REGIONAL WATER PLAN

This page intentionally left blank.

11 IMPLEMENTATION AND COMPARISON TO THE PREVIOUS REGIONAL WATER PLAN

As a result of new statutory requirements from SB660 (82nd Legislative Session) the planning rules (31 TAC §357.45(a)) require that each region report the level of implementation of previously recommended WMSs meeting water shortages. Chapter 11 contains an overview of the implemented water strategies detailed in the *2011 Plan* (Table 11-1). To best appreciate the continued improvements to the Far West Texas water planning process, this chapter also offers a comparison of key components in the *2011 Far West Texas Water Plan* to those in this current *2016 Far West Texas Water Plan*.

11.1 IMPLEMENTATION OF PREVIOUS REGIONAL WATER PLAN

Information needed to report on the implementation of the previous regional water plan was collected through a survey process. Table 11-1 provides a summary of the results of this survey.

Table 11-1. 2011 Far West Texas Strategy Implementation Survey

Sponsor	Recommended Water Management Strategy	Capital Costs	Infrastructure Type	At what level of implementation is the project?	If not implemented, why?	Initial Volume of Water Provided (acft/yr)	Funds Expended to Date ($)	Project Cost ($)	Year the Project is Online	Is this a phased project?	(Phased) Ultimate Volume (acft/yr)	(Phased) Ultimate Project Cost ($)	Year project reaches maximum capacity?	What is the project funding source(s)?	Included in the 2016 Plan?
El Paso	Integrated water management strategy - conjunctive use with additional surface water	$0	Other												
El Paso	Integrated water management strategy - conjunctive use with additional surface water	$140,238,000	Wells	Acquisition and design phase	Financing	5,000	$500,000.00	$140,000,000.00		Yes	580,000	$140,238,000.00	2050	SWIFT	Yes
El Paso	Integrated water management strategy - conservation	$0	No infrastructure	Currently operating		3,000	$1,000,000.00			No	328,000		2060	Local (market issue)	Yes
El Paso	Integrated water management strategy - desalination of agricultural drain water	$16,675,000	Water treatment plant	Sponsor has taken official action to initiate project	Financing	2,700	$75,000.00	$16,875,000.00		No	102,600	$16,875,000.00	2020	SWIFT	Yes
El Paso	Integrated water management strategy - direct reuse	$25,257,000	Pipeline	Acquisition and design phase	Too soon	2,000	$1,500,000.00	$25,237,000.00		Yes	174,000	$25,237,000.00	2040	SWIFT	Yes
El Paso	Integrated water management strategy - import from Dell Valley	$214,113,000	Wells	Acquisition and design phase	Too soon	10,000	$2,000,000.00	$214,000,000.00		Yes	200,000	$214,000,000.00	2060	SWIFT	Yes
El Paso	Integrated water management strategy - import from Diablo Farms	$245,506,000	Wells	Acquisition and design phase	Too soon	10,000	$20,000,000.00	$245,506,000.00		Yes	200,000	$245,506,000.00	2040	SWIFT	Yes
El Paso	Integrated water management strategy - recharge of groundwater with treated surface water	$14,625,000	Wells	Acquisition and design phase	Too soon	5,000	$50,000.00	$14,625,000.00		Yes	200,000	$14,625,000.00	2020	SWIFT	Yes
Fort Bliss	Purchase water from EPWU	$0	No infrastructure	Not implemented	Too soon	N/A	N/A	N/A	N/A	No	N/A	N/A	N/A	N/A	Yes
Horizon Regional MUD	Additional wells and desalination plant expansions	$34,344,000	Wells												
Lower Valley WD	Purchase water from EPWU	$0	No infrastructure												
Marfa	Additional one well	$702,770	Wells	Feasibility study ongoing	Just recently received funding	Unknown	$0.00	$702,770.00	2017	No	1,937	$702,770.00	2017	SWIFT	Yes
San Elizario	Purchase water from LVWD	$0	No infrastructure												
Socorro	Purchase water from LVWD	$0	No infrastructure												
Tornillo WCID	Additional wells	$1,006,762	Wells	Permit application submitted/pending	N/A	317	$68,509.00	$3,767,194.00	2017	Yes	317	$3,767,194.00	2035	USDA-RUS	Yes
Tornillo WCID	Arsenic treatment facility	$1,996,232	Water treatment plant	Acquisition and design phase	N/A	303	$107,506.00	$2,848,376.00	2016	No	303	$2,848,376.00	2035	NAD Bank	Yes
Vinton	Purchase water from EPWU	$0	No infrastructure												

Table 11-1. (Continued) 2011 Far West Texas Strategy Implementation Survey

Sponsor	Recommended Water Management Strategy	Capital Costs	Infrastructure Type	At what level of implementation is the project?	If not implemented, why?	Initial Volume of Water Provided (acft/yr)	Funds Expended to Date ($)	Project Cost ($)	Year the Project is Online	Is this a phased project?	(Phased) Ultimate Volume (acft/yr)	(Phased) Ultimate Project Cost ($)	Year project reaches maximum capacity?	What is the project funding source(s)?	Included in the 2016 Plan?
El Paso County-Other	Purchase water from EPWU	$0	No infrastructure												
El Paso County-Other	Purchase water from EPWU	$0	No infrastructure												
El Paso Irrigation	Irrigation scheduling	$0	No infrastructure	Feasibility study ongoing	N/A	N/A	N/A	N/A		N/A	N/A	N/A	Ongoing		Yes
El Paso Irrigation	Tailwater reuse	$0	No infrastructure	Feasibility study ongoing	N/A	N/A	N/A	N/A		N/A	N/A	N/A	Ongoing		Yes
El Paso Irrigation	Water district delivery systems	$147,635,869	Canal	All phases fully implemented	N/A	Calculation not complete	$3,500,000.00	$25,000,000.00	2011	Yes	N/A	N/A	2020	USBR; TWDB; EPCWID	Yes
El Paso Manufacturing	Purchase water from EPWU	$0	No infrastructure	Not implemented	Other	N/A	N/A	N/A	N/A	No	N/A	N/A	N/A	N/A	Yes
El Paso SEP	Purchase water from EPWU	$0	No infrastructure												
El Paso SEP	Purchase water from EPWU	$0	No infrastructure												
Hudspeth Irrigation	Irrigation scheduling	$0	No infrastructure												
Hudspeth Irrigation	Tailwater reuse	$0	No infrastructure												

11.2 COMPARISON TO PREVIOUS PLAN

The following section includes a brief summary that shows how the *2016 Plan* differs from the *2011 Plan*. Comparisons include:

1. Water demand projections;
2. Drought of record and the hydrologic and modeling assumptions on which plans are based;
3. Water availability at the source;
4. Existing water supplies of WUGs;
5. WUG and WWP needs;
6. Recommended and alternative water management strategies.

11.2.1 Water Demand Projections

The following Table 11-2 provides a comparison between *2011 and 2016 Plan* water demand projections. The general decrease in water demand in the latest *Plan* is mostly the result of lower population projections based on the 2010 census.

Table 11-2. Water Demand Projections Comparison
(Acre-Feet/Year)

County	Plan	2010	2020	2030	2040	2050	2060	2070
Brewster	2011	5,151	5,214	5,220	5,206	5,276	5,280	
	2016		5,192	5,210	5,190	5,181	5,176	5,171
Culberson	2011	49,530	48,630	47,685	46,741	45,814	44,918	
	2016		41,461	41,395	40,739	39,664	38,611	37,634
El Paso	2011	384,484	406,105	423,412	431,678	445,014	45,9468	
	2016		406,422	421,884	430,571	445,175	461,048	476,929
Hudspeth	2011	183,653	179,883	176,183	172,537	168,976	165,494	
	2016		180,360	176,653	173,040	169,502	166,032	162,635
Fort Davis	2011	1,604	1,657	1,691	1,724	1,760	1,797	
	2016		3,520	3,497	3,475	3,458	3,439	3,425
Presidio	2011	22,939	22,825	22,714	22,494	22,192	21,876	
	2016		6,938	6,530	6,533	6,566	6,596	6,625
Terrell	2011	765	770	763	757	755	753	
	2016		1,511	1,604	1,556	1,416	1,283	1,178
Total	2011	648,126	665,084	67,7668	681,137	689,787	699,586	
	2016		645,404	656,773	661,104	670,962	682,185	693,597

11.2.2 Drought of Record and Hydrologic and Modeling Assumptions

The **drought of record** consideration for water supply analysis for both the *2011 and 2016 Plans* is the drought of the 1950s. However, the *2016 Plan* does recognize that the current drought conditions as particularly witnessed in the summer of 2011 with a significantly low lake level at Elephant Butte Reservoir and corresponding cutback on irrigation allocations is having a significant impact on local water supply sources.

Surface water availability for both the *2011 and 2016 Plans* is based on Run 3 of the TCEQ Water Availability Models (WAMs) for the Rio Grande and Pecos Rivers.

Groundwater availability in the *2011 Plan* was based on TWDB Groundwater Availability Model (GAMs) simulations as performed by the planning group hydrogeological consultants. In the *2016 Plan* groundwater availability is based on the Modeled Available Groundwater (MAG) volumes 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 based on science-based aquifer hydrologic characteristics.

11.2.3 Water Availability at the Source

As explained in the previous section, surface water source availability has not changed between the two Plans; however, groundwater availability has changed significantly due to the new GMA MAG requirements. In total, water supply from the source increased from 597,511 acre-feet per year in the *2011 Plan* to 1,039,769 acre-feet per year in the *2016 Plan*, with all the decrease occurring in the groundwater sources. The following Table 11-3 depicts these changes.

Table 11-3. Comparison of Source Supply Availability
(Acre-Feet/Year)

Water Supply Source	County	2011 Plan	2016 Plan
Upper Rio Grande	El Paso	66,631	66,631
	Hudspeth	632	632
Upper Rio Grande (Return Flows)	El Paso	42,134	41,102
	Hudspeth	334	334
Lower Rio Grande	Brewster	8,082	8,082
	Hudspeth	518	518
	Presidio	10,853	10,853
	Terrell	152	152
Pecos River	Terrell	524	524
Direct Reuse	El Paso	6,000	6,000
Hueco Bolson Aquifer	El Paso	110,000	428,000
	Hudspeth	16,000	16,000
Mesilla Bolson Aquifer	El Paso	52,000	52,000
Edwards-Trinity (Plateau) Aquifer	Brewster	300	1,394
	Culberson (GCD)	55	2,154
	Culberson (Non-GCD)		3,690
	Jeff Davis	200	9,288
	Terrell	2,200	1,421
Bone Spring - Victorio Peak Aquifer	Hudspeth	63,000	101,429
Capitan Reef Aquifer	Brewster	50	2,100
	Culberson	20,000	7,580
	Hudspeth	5,100	5,100

Table 11-3. (Continued) Comparison of Source Supply Availability
(Acre-Feet/Year)

Water Supply Source	County	2011 Plan	2016 Plan
Igneous Aquifer	Brewster	5,000	2,586
	Culberson	100	99
	Jeff Davis	2,000	4,584
	Presidio	7,000	4,064
Marathon Aquifer	Brewster	200	7,327
Rustler Aquifer	Brewster	0	0
	Culberson	1,000	1,000
West Texas Bolson - (Red Light Draw) Aquifer	Hudspeth	1,631	1,631
West Texas Bolson - (Eagle Flat) Aquifer	Hudspeth	2,869	2,869
West Texas Bolson - (Green River Valley) Aquifer	Hudspeth	82	82
	Jeff Davis	82	82
	Presidio	82	82
West Texas Bolson - (Presidio-Redford) Aquifer	Presidio	8,000	6,282
Upper Salt Basin Aquifer	Hudspeth		250
	Culberson		16,851
West Texas Bolson (Wild Horse, Lobo and Ryan) Aquifer	Culberson	38,000	35,749
	Jeff Davis	8,000	6,055
	Presidio	12,000	9,112
Other Aquifers - (Cretaceous Limestones)	Brewster	2,200	2,800
	Presidio		1,000
Other Aquifers – (Diablo Plateau)	Hudspeth		26,400
Other Aquifers - (Balmorhea Alluvium)	Jeff Davis	500	500
Other Aquifers - (Rio Grande Alluvium)	El Paso	89,000	130,380
	Hudspeth	15,000	15,000
Total Combined Source Supply		**597,511**	**1,039,769**

11.2.4 Existing Water Supplies of WUGs

Table 11-4 compares *2011 Plan and 2016 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.

Table 11-4. Existing Water Supplies of WUGs
(Acre-Feet/Year)

County	Water User	Supply source	2011 Plan	2016 Plan
Brewster	Alpine	Igneous Aquifer	3,843	1,428
	Alpine	Igneous Aquifer | Jeff Davis County	1,021	738
	County-Other	Edwards-Trinity Plateau Aquifer	23	28
	County-Other	Igneous Aquifer	273	554
	County-Other	Marathon Aquifer	68	96
	County-Other	Other Aquifer	91	388
	Manufacturing	Igneous Aquifer	4	4
	Mining	Igneous	348	0
	Mining	Other Aquifer	348	0
	Livestock	Capitan Reef Complex	-	112
	Livestock	Edwards-Trinity Plateau Aquifer	239	112
	Livestock	Igneous Aquifer	240	112
	Livestock	Marathon Aquifer	80	31
	Livestock	Other Aquifer	239	0
	Livestock	Rio Grande Livestock Local Supply	-	19
	Irrigation	Igneous Aquifer	-	291
	Irrigation	Other Aquifer	1,330	2,381
	Irrigation	Rio Grande Run-Of-River	7,460	600
		Brewster County Total Existing Supply	15,607	6,894
Culberson	Van Horn	West Texas Bolsons Aquifer	2,084	1,351
	County-Other	Edwards-Trinity Plateau Aquifer	8	3
	County-Other	Rustler Aquifer	8	1
	County-Other	West Texas Bolsons Aquifer	62	136
	Mining	Rio Grande Other Local Supply	-	78
	Mining	Rustler Aquifer	849	47
	Mining	West Texas Bolsons Aquifer	1,312	90
	Livestock	Edwards-Trinity Plateau	47	29
	Livestock	Rio Grande Livestock Local Supply	-	15
	Livestock	Rustler Aquifer	120	28
	Livestock	West Texas Bolsons Aquifer	299	228
	Irrigation	Capitan Reef Complex	12,873	7,563
	Irrigation	West Texas Bolsons Aquifer	33,886	32,422
		Culberson County Total Existing Supply	51,548	41,991
El Paso	Anthony	Hueco-Mesilla Bolson Aquifer	3,065	1,202
	Clint	Hueco-Mesilla Bolson Aquifer	276	276
	El Paso	Direct Reuse	6,000	6,000
	El Paso	Hueco-Mesilla Bolson Aquifer	75,900	115,000
	El Paso	Rio Grande Run-Of-River	45,667	10,000
	El Paso County Tornillo WID	Hueco-Mesilla Bolson Aquifer	1,225	484
	El Paso WCID #4	Hueco-Mesilla Bolson Aquifer	4,445	1,065
	Fort Bliss	Hueco-Mesilla Bolson Aquifer	21,476	1,622
	Fort Bliss	Rio Grande Run-Of-River	218	0
	Horizon City	Hueco-Mesilla Bolson Aquifer		2,222

Table 11-4. (Continued) Existing Water Supplies of WUGs
(Acre-Feet/Year)

County	Water User	Supply source	2011 Plan	2016 Plan
El Paso	Horizon City	Rio Grande River Alluvium Aquifer Brackish		884
	Horizon Regional MUD	Hueco-Mesilla Bolson Aquifer	560	1,746
	Horizon Regional MUD	Rio Grande River Alluvium Aquifer Brackish	3,360	694
	Lower Valley WD	Hueco-Mesilla Bolson Aquifer	876	1,121
	Lower Valley WD	Rio Grande Run-Of-River	245	
	Socorro	Hueco-Mesilla Bolson Aquifer	1,666	2,959
	Socorro	Rio Grande Run-Of-River	1,293	
	Vinton	Hueco-Mesilla Bolson Aquifer	200	400
	Vinton	Rio Grande Run-Of-River	200	
	County-Other	Hueco-Mesilla Bolson Aquifer	6,278	6,278
	Manufacturing	Hueco-Mesilla Bolson Aquifer	9,181	7,297
	Mining	Hueco-Mesilla Bolson Aquifer	103	680
	Mining	Rio Grande Other Local Supply		3,026
	Mining	Rio Grande River Alluvium Aquifer Brackish	66	2,000
	Steam Electric Power	Hueco-Mesilla Bolson Aquifer	3,131	3,286
	Livestock	Hueco-Mesilla Bolson Aquifer	1,742	603
	Livestock	Rio Grande Livestock Local Supply		26
	Irrigation	Rio Grande Indirect Reuse	37,697	37,697
	Irrigation	Rio Grande River Alluvium Aquifer Brackish	80,000	80,000
	Irrigation	Rio Grande Run-Of-River	18,457	56,631
		El Paso County Total Existing Supply	323,327	343,327
Hudspeth	Sierra Blanca	West Texas Bolsons Aquifer | Culberson	351	842
	County-Other	Bone Spring Victorio-Peak Aquifer	126	63
	County-Other	Hueco-Mesilla Bolson Aquifer	241	122
	County-Other	Rio Grande River Alluvium Aquifer Brackish	45	731
	Manufacturing	Rio Grande River Alluvium Aquifer Brackish	10	10
	Mining	Rio Grande Other Local Supply		240
	Mining	Rio Grande River Alluvium Aquifer Brackish	2	21
	Mining	West Texas Bolsons Aquifer		220
	Livestock	Bone Spring Victorio-Peak Aquifer	31	23
	Livestock	Capitan Reef Complex Aquifer	12	10
	Livestock	Hueco-Mesilla Bolson Aquifer	88	64
	Livestock	Other Aquifer	438	322
	Livestock	Rio Grande Livestock Local Supply		81
	Livestock	West Texas Bolsons Aquifer	57	41
	Irrigation	Bone Spring Victorio-Peak Aquifer	62,843	63,843
	Irrigation	Capitan Reef Complex Aquifer	5,000	5,000
	Irrigation	Rio Grande Indirect Reuse	334	334
	Irrigation	Rio Grande River Alluvium Aquifer Brackish	15,000	14,000
	Irrigation	Rio Grande Run-Of-River	816	816
		Hudspeth County Total Existing Supply	85,394	86,783

Table 11-4. (Continued) Existing Water Supplies of WUGs
(Acre-Feet/Year)

County	Water User	Supply source	2011 Plan	2016 Plan
Jeff Davis	Fort Davis	Igneous Aquifer	912	343
	County-Other	Edwards-Trinity Plateau Aquifer	3	10
	County-Other	Igneous Aquifer	151	428
	County-Other	Rio Grande River Alluvium Aquifer		196
	County-Other	West Texas Bolsons Aquifer	8	38
	Livestock	Edwards-Trinity Plateau Aquifer	141	117
	Livestock	Igneous Aquifer	84	70
	Livestock	Other Aquifer	253	
	Livestock	Rio Grande Livestock Local Supply		25
	Livestock	Rio Grande River Alluvium Aquifer		212
	Livestock	West Texas Bolsons Aquifer	85	71
	Irrigation	Igneous Aquifer	735	735
	Irrigation	Rio Grande Other Local Supply		50
	Irrigation	West Texas Bolsons Aquifer	2,572	2,572
	Jeff Davis County Total Existing Supply		4,944	4,867
Presidio	Marfa	Igneous Aquifer	4,839	1,774
	Presidio	West Texas Bolsons Aquifer	3,419	3,589
	County-Other	Igneous Aquifer	36	353
	County-Other	Other Aquifer	2	223
	County-Other	West Texas Bolsons Aquifer	56	12
	Mining	Other Aquifer	10	403
	Livestock	Igneous Aquifer	142	81
	Livestock	Other Aquifer	110	143
	Livestock	Rio Grande Livestock Local Supply		41
	Livestock	West Texas Bolsons Aquifer	142	143
	Irrigation	Igneous Aquifer	1,318	400
	Irrigation	Rio Grande Run-Of-River	10,853	6,140
	Irrigation	West Texas Bolsons Aquifer	8,351	2,461
	Presidio County Total Existing Supply		29,278	15,763
Terrell	Sanderson	Edwards-Trinity Plateau Aquifer	1,081	527
	County-Other	Edwards-Trinity Plateau Aquifer	39	61
	Mining	Edwards-Trinity Plateau Aquifer	142	184
	Mining	Rio Grande Other Local Supply		40
	Livestock	Edwards-Trinity Plateau Aquifer	411	234
	Livestock	Rio Grande Livestock Local Supply		4
	Irrigation	Edwards-Trinity Plateau Aquifer	494	415
	Irrigation	Rio Grande Run-Of-River	152	676
	Terrell County Total Existing Supply		2,319	2,141
Far West Texas Total Existing Supply			**512,417**	**501,766**

11.2.5 WUG and WWP Needs

Water supply needs occur when an entity's (WUG's) projected water demand (Table 11-2) exceeds its supply availability (Table 11-4). Table 11-5 compares those entities in the *2011 Plan* that are projected to experience a water supply need at some decade in the next 50 years to those in the *2016 Plan*. The dramatic difference between WUG needs in the two *Plans* is primarily the result of the decreased supply source availability (Table 11-3) shown in the *2016 Plan*.

Table 11-5. WUG and WWP Needs Comparison
(Acre-Feet/Year)

2011 Plan								
County	**WUG/WWP**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	
El Paso	El Paso					4,856	13,693	
	Horizon Regional MUD		1,607	3,304	4,764	6,245	7,726	
	Lower Valley Water District		605	1,161	1,604	2,078	2,551	
	San Elizario		934	1,794	2,481	3,214	3,947	
	Socorro		507	1,018	1,402	1,836	2,271	
	El Paso County Tornillo WID				62	284	505	
	Vinton		214	398	562	726	891	
	County Other		3,114	5,625	7,589	9,584	11,876	
	Manufacturing		813	1,511	2,186	2,760	3,674	
	Steam Electric Power		3,806	4,980	6,410	8,153	10,279	
	Irrigation	110,957	106,644	104,694	96,226	92,425	88,686	
Hudspeth	Irrigation	98,634	94,847	91,139	87,508	83,952	80,470	
2016 Plan								
County	**WUG/WWP**		**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Culberson	Mining		291	1,025	1,178	895	628	425
El Paso	El Paso					8,978	19,602	29,792
	Fort Bliss		26	40	74	128	178	228
	Horizon City		1,352	3,203	4,941	6,669	8,308	9,853
	Horizon Regional MUD		1,233	2,582	3,851	5,115	6,317	7,451
	Lower Valley Water District		2,453	3,228	3,965	4,734	5,500	6,227
	Socorro		217	488	757	1,069	1,406	1,732
	County Other		368	764	1,220	1,754	2,259	2,745
	Manufacturing		8,841	9,968	11,058	11,985	13,461	15,050
	Mining					242	987	1,833
	Steam Electric Power		3,651	4,825	6,255	7,998	10,124	12,651
	Irrigation		75,165	71,278	60,950	55,026	50,512	46,834
Hudspeth	Mining					2	11	21
	Irrigation		94,847	91,139	87,508	83,952	80,470	77,060
Terrell	Mining		449	552	516	382	259	161

11.2.6 Recommended Water Management Strategies

A total of 24 water management strategies (Table 11-6) for 15 water user groups (WUGs) were recommended in the *2011 Plan*, with a total capital cost of $842,299,633. As a result of more WUGs projecting a water supply need (Table 11-5) in the *2016 Plan*, a total of 64 strategies (Table 11-7) for 27 WUGs were recommended with a total capital cost of $1,903,771,872.

Table 11-6. Summary of 2011 Plan Recommended Water Management Strategies
(Acre-Feet per Year)

County Used	Water User Group	Strategy	Strategy ID	Source	Strategy Supply (Acre-Feet/Year)						Total Capital Cost
					2010	2020	2030	2040	2050	2060	
El Paso	City of El Paso (EPWU)	IWMS - Direct reuse	E-1	Treated EPWU blended sources		2,000	4,000	6,000	6,000	6,000	$25,257,000
		IWMS - Conservation	E-2	NA		3,000	7,000	11,000	16,000	22,000	NA
		IWMS - Recharge of groundwater with treated surface water	E-3	Treated EPWU blended sources		5,000	5,000	5,000	5,000	5,000	$14,625,000
		IWMS - Desalination of agricultural drain water	E-4	Treated Agricultural Drain Water		2,700	2,700	2,700	2,700	2,700	$16,875,000
		IWMS - Conjunctive use with additional surface water	E-5	Upper Rio Grande		5,000	15,000	20,000	20,000	20,000	$140,238,000
		IWMS - Import from Dell Valley	E-6	Bone Spring-Victorio Peak Aquifer					10,000	20,000	$214,113,000
		IWMS - Import from Diablo Farms	E-7	Capitan Reef Aquifer				10,000	10,000	10,000	$245,506,000
	Lower Valley Water District	Purchase water from EPWU	E-10	EPWU blended sources		605	1,161	1,604	2,078	2,551	$0
	San Elizario	Purchase water from LVWD	E-11	EPWU blended sources		934	1,794	2,481	3,214	3,947	$0
	Socorro	Purchase water from LVWD	E-12	EPWU blended sources		507	1,018	1,402	1,836	2,271	$0
	Fort Bliss	Purchase water from EPWU	E-9	EPWU blended sources	3,376	8,992	8,998	8,998	9,004	9,004	$0
	Vinton	Purchase water from EPWU	E-14	EPWU blended sources		214	398	562	726	891	$0
	El Paso County Other	Purchase Water from EPWU	E-15	EPWU blended sources		3,114	5,625	7,589	9,584	11,876	$0
	Manufacturing	Purchase water from EPWU	E-16	EPWU blended sources		813	1,511	2,186	2,760	3,674	$0
	Steam Electric Power	Purchase water from EPWU	E-17	EPWU blended sources		3,806	4,980	6,410	8,153	10,279	$0
	Horizon Regional MUD	Additional wells and desalination plant expansion	E-8	Rio Grande Alluvium		1,607	3,304	4,764	6,245	7,726	$34,344,000
	El Paso County Tornillo WID	Additional wells	E-13	Hueco Bolson Aquifer		175	175	350	350	350	$1,006,762
	El Paso County Tornillo WID	Arsenic treatment facility	E-23	Hueco Bolson Aquifer		276	276	276	276	276	$1,996,232
	Irrigation (EPCWID#1)	Irrigation scheduling (Conservation)	E-18	Upper Rio Grande		1,740	1,740	1,740	1,740	1,740	$0
		Water district delivery systems (Conservation)	E-19	Upper Rio Grande		25,000	25,000	25,000	25,000	25,000	$147,635,869
		Tailwater reuse	E-20	Upper Rio Grande		1,723	1,723	1,723	1,723	1,723	$0
Hudspeth	Irrigation (HCUWCD#1)	Irrigation scheduling (Conservation)	E-21	Bone Spring-Victorio Peak Aquifer		3,535	3,535	3,535	3,535	3,535	$0
		Tailwater reuse	E-22	Bone Spring-Victorio Peak Aquifer		589	589	589	589	589	$0
	Irrigation (HCCRD#1)	No feasible strategy	NA	None		NA	NA	NA	NA	NA	NA
Presidio	City of Marfa	Additional 1 well	E-24	Igneous Aquifer		500	500	500	500	500	$702,770

Table 11-7. Summary of 2016 Plan Recommended Water Management Strategies
(Acre-Feet per Year)

County	Water User Group	Strategy	Source	2016 Strategy ID	Strategy Supply (Acre-Feet/Year)						Total Capital Cost (Table 5-3)
					2020	2030	2040	2050	2060	2070	
Brewster	Brewster County Other (Marathon WSSService)	Water loss audit and main-line repair	Conservation	E-1	65	65	65	65	65	65	$426,000
	Brewster County Other (Rio Grande Village BBNP)	Water loss audit and main-line repair	Conservation	E-2	6	6	6	6	6	6	$607,000
	Brewster County Other (Panther Junction BBNP Plt)	Water loss audit and main-line repair	Conservation	E-3	2	2	2	2	2	2	$759,000
Culberson	City of Van Horn	Water loss audit and main-line repair	Conservation	E-4	30	30	30	30	30	30	$1,197,000
	*Culberson County Mining	Additional groundwater wells	Rustler Aquifer	E-5	590	590	590	590	590	590	$608,000
		Additional groundwater well	West Texas Bolsons Aquifer / Upper Salt Basin	E-6	590	590	590	590	590	590	$675,000
El Paso	*Town of Anthony	Water loss audit and main-line repair	Conservation	E-7	7	7	7	7	7	7	$759,000
		Arsenic treatment facility	Mesilla Bolson Aquifer	E-8	2,800	2,800	2,800	2,800	2,800	2,800	$9,952,000
		Additional groundwater well	Hueco-Mesilla Bolson Aquifer	E-9	960	960	960	960	960	960	$1,244,471
	*City of El Paso (EPWU)	Municipal conservation programs	Conservation	E-10	1,870	2,110	1,160	2,550	5,530	5,910	$0
		Advanced purified water at the Haskell and NW WWTPs	Reuse Treated Wastewater	E-11			3,000	7,500	12,000	16,500	$291,800,000
		Advanced purified water at the Bustamante WWTP	Reuse Treated Wastewater	E-12	8,000	9,000	10,000	10,000	10,000	10,000	$94,096,000
		Recharge of Hueco Aquifer groundwater with treated surface water from Jonathan Rogers Plant	Rio Grande	E-13	5,000	5,000	5,000	5,000	5,000	5,000	$2,495,000
		Treatment & reuse of agricultural drain water	Agricultural Drain Water	E-14		2,700	2,700	2,700	2,700	2,700	$41,679,000
		Expansion of local well fields	Hueco-Mesilla Bolson Aquifer	E-15	3,880	7,760	11,640	15,520	19,400	23,280	$32,712,000
		Brackish Groundwater at the Jonathan Rogers WTP	Rio Grande Alluvium Aquifer	E-16			11,000	11,000	11,000	11,000	$65,865,000
		Expansion of the Kay Bailey Hutchison Desal Plant	Hueco Bolson Aquifer	E-17	1,260	2,520	2,520	2,520	2,520	2,520	$37,200,000

Table 11-7. (Continued) Summary of 2016 Plan Recommended Water Management Strategies (Acre-Feet per Year)

County	Water User Group	Strategy	Source	2016 Strategy ID	Strategy Supply (Acre-Feet/Year)						Total Capital Cost (Table 5-3)
					2020	2030	2040	2050	2060	2070	
El Paso	*City of El Paso (EPWU)	Groundwater from Hueco Ranch	Other Aquifer / Diablo Plateau	E-18			5,000	5,000	5,000	5,000	$155,858,000
		Groundwater from Southern Hudspeth County	Other Aquifer / Diablo Plateau	E-19	10,000	10,000	10,000	10,000	10,000	10,000	$98,980,000
		Expansion of the Jonathan Rogers WTP	Rio Grande	E-20	6,500	6,500	6,500	6,500	6,500	6,500	$95,186,653
		Riverside Regulating Reservoir	Rio Grande & Stormwater Run-off	E-21	6,500	6,500	6,500	6,500	6,500	6,500	$20,754,157
		Groundwater from Diablo Farms	Capitan Reef Complex Aquifer	E-22				10,000	10,000	10,000	$273,507,000
		Groundwater from Dell City area	Bone Spring-Victorio Peak Aquifer	E-23					10,000	20,000	$303,185,000
	*Lower Valley Water District	Public conservation education	Conservation	E-24	36	43	51	59	66	73	$0
		Purchased water from EPWU	EPWU Blended Source	E-25	2,453	3,228	3,965	4,734	5,500	6,227	$0
		Surface water treatment plant & transmission line	Rio Grande	E-26	6,700	6,700	6,700	6,700	6,700	6,700	$34,080,000
		Groundwater from proposed Well field	Other Aquifer / Rio Grande Alluvium Aquifer	E-27	6,800	6,800	6,800	6,800	6,800	6,800	$37,490,000
		Groundwater from proposed Well field	Hueco Bolson Aquifer	E-28	6,800	6,800	6,800	6,800	6,800	6,800	$41,070,000
		Wastewater treatment facility and ASR	Reuse Treated Wastewater	E-29	3,808	3,808	3,808	3,808	3,808	3,808	$18,108,000
	*City of Socorro	Public conservation education	Conservation	E-30	32	34	37	40	44	47	$0
		Purchased water from LVWD	EPWU Blended Source	E-31	217	488	757	1,069	1,406	1,732	$0
	*Horizon City	Public conservation education	Conservation	E-32	45	63	80	98	114	130	$0
		Purchased water from Horizon Regional MUD	Other Aquifer / Rio Grande Alluvium Aquifer	E-33	1,352	3,203	4,941	6,669	8,308	9,853	$0

Table 11-7. (Continued) Summary of 2016 Plan Recommended Water Management Strategies
(Acre-Feet per Year)

County	Water User Group	Strategy	Source	2016 Strategy ID	Strategy Supply (Acre-Feet/Year)						Total Capital Cost (Table 5-3)
					2020	2030	2040	2050	2060	2070	
El Paso	*Horizon Regional MUD	Public conservation education	Conservation	E-34	37	50	63	76	88	99	$0
		Additional wells & expansion of desal plant	Hueco Bolson & Other Aquifer / Rio Grande Alluvium Aquifer	E-35	2,585	5,785	8,792	11,784	14,625	17,304	$56,443,000
	*Fort Bliss	Public conservation education	Conservation	E-36	16	17	17	18	18	19	$0
		Purchased water from EPWU	EPWU Blended Source	E-37				100	100	100	$0
	El Paso County Tornillo WID	Additional groundwater well & transmission line	Hueco Bolson Aquifer	E-38	333	333	333	333	333	333	$1,726,000
		Arsenic treatment facility	Hueco Bolson Aquifer	E-39	276	276	276	276	276	276	$3,114,000
	City of Vinton	High capacity water lines for improved distribution of water from EPWU	EPWU Blended Source	E-40	400	400	400	400	400	400	$4,192,000
	*El Paso County Other	Public conservation education	Conservation	E-41	0	9	8	8	8	7	$0
		Purchased water from EPWU	EPWU Blended Source	E-42	368	764	1,220	1,754	2,259	2,745	$0
	*El Paso County Irrigation (EPCWID #1)	Irrigation scheduling	Conservation	E-43	1,740	1,740	1,740	1,740	1,740	1,740	$0
		Tailwater reuse	Conservation	E-44	1,723	1,723	1,723	1,723	1,723	1,723	$0
		Improvements to water district delivery system	Conservation	E-45	25,000	25,000	25,000	25,000	25,000	25,000	$157,777,783
	*El Paso County Manufacturing	Purchased water from EPWU	EPWU Blended Source	E-46	8,841	9,968	11,058	11,985	13,461	15,050	$0
	*El Paso County Mining	Additional groundwater wells	Hueco-Mesilla Bolson Aquifer	E-47				242	987	1,833	$969,000
	*El Paso County Steam Electric Power	Purchased water from EPWU	EPWU Blended Source	E-48	3,651	4,825	6,255	7,998	10,124	12,651	$0
Hudspeth	Hudspeth County Other (Dell City)	Water loss audit and main-line repair	Conservation	E-49	1	1	1	1	1	1	$1,614,000
		Brackish groundwater desal facility	Bone Spring-Victorio Peak Aquifer	E-50	111	111	111	111	111	111	$1,299,000

Table 11-7. (Continued) Summary of 2016 Plan Recommended Water Management Strategies (Acre-Feet per Year)

County	Water User Group	Strategy	Source	2016 Strategy ID	Strategy Supply (Acre-Feet/Year)						Total Capital Cost (Table 5-3)
					2020	2030	2040	2050	2060	2070	
Hudspeth	Hudspeth County Other (Fort Hancock WCID)	Water loss audit and main-line repair	Conservation	E-51	3	3	3	3	3	3	$292,000
		Additional well & RO treatment facility	Hueco-Mesilla Bolson Aquifer	E-52	565	565	565	565	565	565	$6,109,000
	Hudspeth County Other (City of Sierra Blanca - Hudspeth Co. WCID #1)	Additional transmission line to supply connections outside of the District	West Texas Bolsons Aquifer / Salt Basin	E-53	351	351	351	351	351	351	$1,429,000
	*Hudspeth Irrigation (HCCRD #1)	Additional groundwater wells	Other Aquifer / Rio Grande Alluvium Aquifer	E-54	230	230	230	230	230	230	$173,000
	Hudspeth Irrigation (HCUWCD #1)	Irrigation scheduling	Conservation	E-55	3,535	3,535	3,535	3,535	3,535	3,535	$0
		Tailwater reuse	Conservation	E-56	589	589	589	589	589	589	$0
	*Hudspeth County Mining	Additional groundwater well	West Texas Bolsons Aquifer / Eagle Flat	E-57	30	30	30	30	30	30	$449,000
Jeff Davis	Fort Davis WSC	Additional groundwater well	Igneous Aquifer	E-58	274	274	274	274	274	274	$507,000
		Additional transmission line to connect Fort Davis WSC to Fort Davis Estates	Igneous Aquifer	E-59	114	114	114	114	114	114	$1,068,000
	Jeff Davis County Other (Town of Valentine)	Additional groundwater well	West Texas Bolsons Aquifer / Salt Basin	E-60	65	65	65	65	65	65	$402,808
Presidio	City of Marfa	Additional groundwater well	Igneous Aquifer	E-61	785	785	785	785	785	785	$1,143,000
	City of Presidio	Water loss audit and main-line repair	Conservation	E-62	9	9	9	9	9	9	$2,172,000
		Additional groundwater well	West Texas Bolsons Aquifer / Presidio-Redford	E-63	120	120	120	120	120	120	$1,861,000
Terrell	*Terrell County Mining	Additional groundwater wells	Edwards-Trinity (Plateau) Aquifer	E-64	0	0	0	0	0	0	$738,000
				Totals	**128,054**	**145,980**	**177,676**	**206,835**	**238,670**	**268,191**	**1,903,771,872**

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