FAR WEST TEXAS WATER PLAN

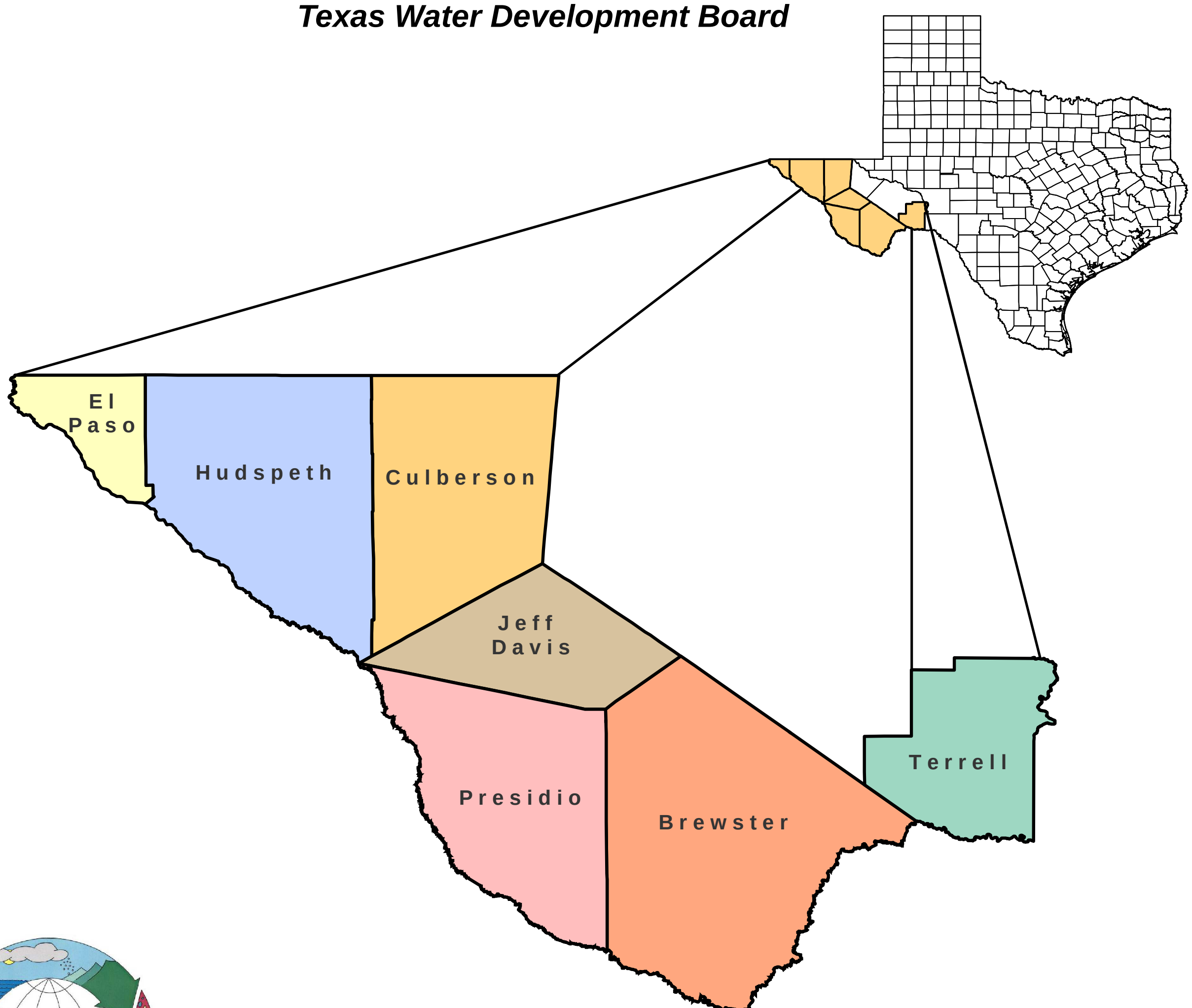
January 2011

Prepared by

Far West Texas Water Planning Group

Prepared for

Texas Water Development Board



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EXECUTIVE SUMMARY

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.

Far West Texas is bounded on the north by New Mexico, on the south and west by the Rio Grande and the Republic of Mexico, 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.

In January of 2006, the second round of regional water planning was concluded with the adoption of the 2006 *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 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 *2011 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 *2011 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. 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 of the State. In the year 2010, approximately 97 percent (833,640) of the Region's 863,190 residents are projected to reside in El Paso County, where the population density is 760 persons per square mile. 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.

El Paso, one of the fastest growing cities in Texas, is the largest city in the Region, with a year-2010 projected population of 637,481. This is 76 percent of the total population of El Paso County and 74 percent of the Region's total population.

The year-2010 projected populations of cities in the six rural counties are as follows: Alpine, Brewster County (6,320); Van Horn, Culberson County (2,743); Sierra Blanca, Hudspeth County (608); Fort Davis, Jeff Davis County (1,700); Marfa, Presidio County (2,585); Presidio, Presidio County (5,360); and Sanderson, Terrell County (921). Population of 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 68,006, or eight percent of the total rural population.

The regional population is projected to nearly double to 1,542,824 by the year 2060, which is an increase of 679,634 citizens. Most of this increase (671,983) is projected to occur in El Paso County.

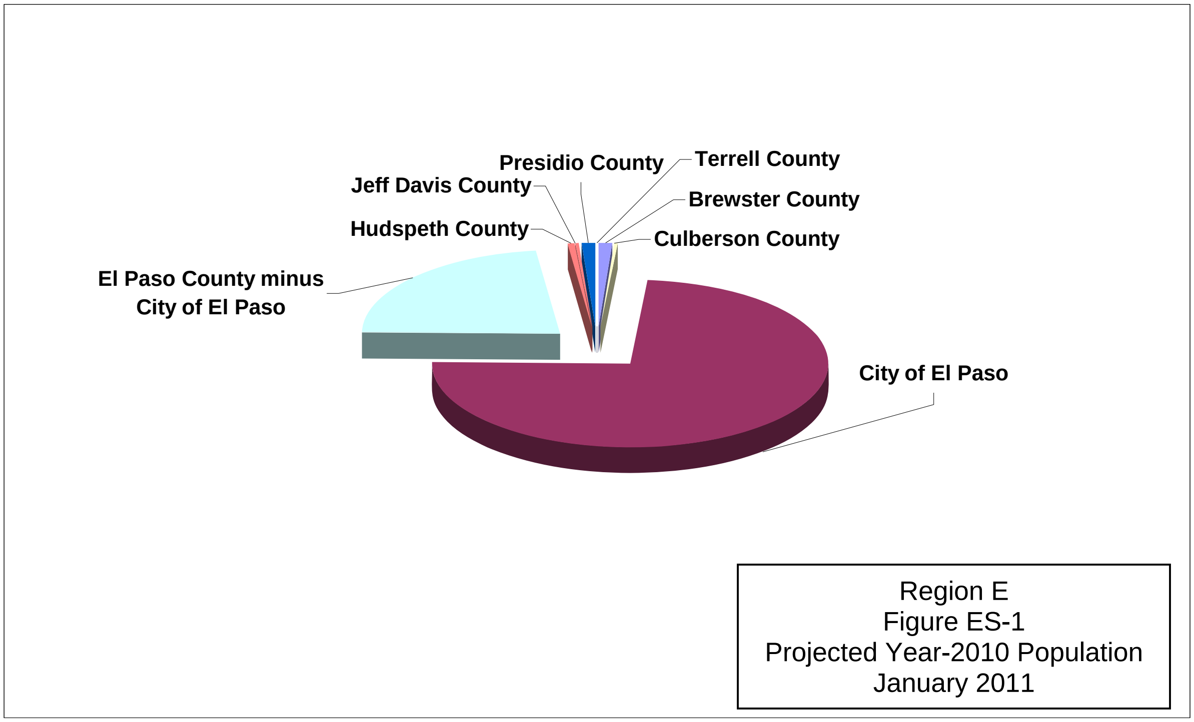

FIGURE ES-1. PROJECTED YEAR-2010 POPULATION

Total projected year-2010 water consumptive use in Far West Texas was 648,126 acre-feet. The largest category of use was irrigation (499,092 acre-feet), followed by municipalities and county-other (129,476 acre-feet), manufacturing (9,187 acre-feet), livestock (4,843 acre-feet), steam-electric cooling (3,131 acre-feet), and mining (2,397 acre-feet). Seventy-seven percent of water use in the Region is by the agricultural sector in support of irrigation. Twenty percent is used by municipalities and the remaining 3 percent supports manufacturing, steam-electric generation, livestock and mining.

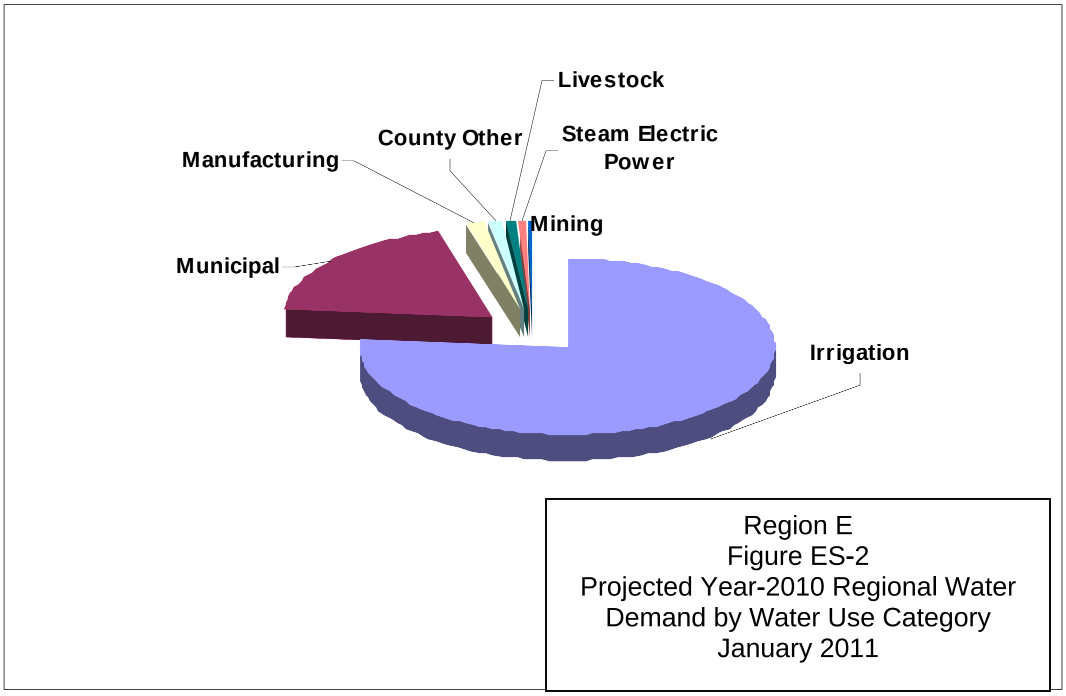

FIGURE ES-2. PROJECTED YEAR-2010 REGIONAL WATER DEMAND BY WATER USE CATEGORY

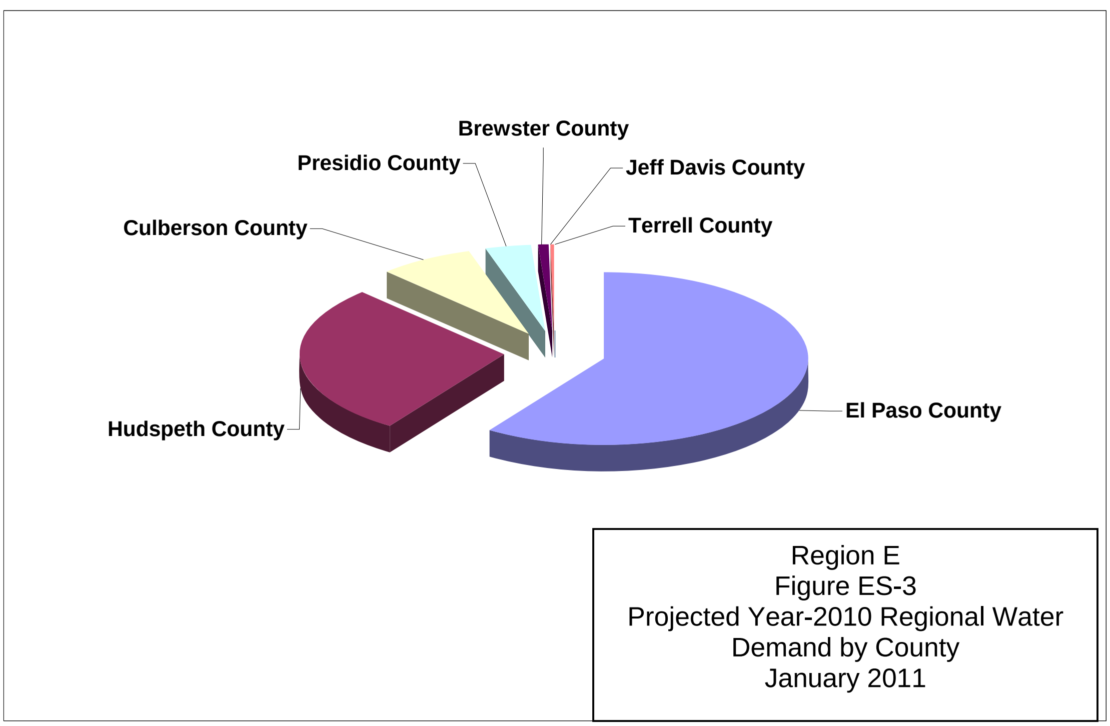

FIGURE ES-3. PROJECTED YEAR-2010 REGIONAL WATER DEMAND BY COUNTY

The potential role of conservation is an important factor in projecting future water supply requirements. In this 2011 Regional 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.

Projected Municipal and County Other Water Demand By County (Ac-ft/yr)

	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Brewster	2,242	2,336	2,358	2,360	2,445	2,466
Culberson	913	968	985	982	977	977
El Paso	123,162	144,481	161,868	176,499	191,321	206,475
Hudspeth	410	427	435	420	415	415
Jeff Davis	505	562	599	635	674	515
Presidio	2,006	2,290	2,570	2,733	2,806	2,857
Terrell	238	244	239	235	234	234

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 (77 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.

Projected Irrigation Water Demand By County (Ac-ft/yr)

	2010	2020	2030	2040	2050	2060
Brewster	1,622	1,613	1,605	1,596	1,588	1,580
Culberson	46,759	45,758	44,779	43,821	42,883	41,965
El Paso	247,111	242,798	240,848	232,380	228,579	224,840
Hudspeth	182,627	178,840	175,132	171,501	167,945	164,463
Jeff Davis	3,119	3,057	2,995	2,935	2,875	2,816
Presidio	25,156	24,646	24,145	23,655	23,175	22,705
Terrell	78	77	75	73	72	70

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. Future supplies are anticipated from the following “imported” groundwater sources:

- Bismark Mine (26,000 acre-ft/yr)
- Mesilla (26,000 acre-ft/yr)

- Somero (28,000 acre-ft/yr)
- Profundo (31,000 acre-ft/yr)

In addition, plans are also being developed to convert 38,000 acre-ft/yr 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-ft/yr 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. The entire Far West Texas planning region is located within the Rio Grande Basin. 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. 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 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 acceptable levels of water level decline as simulated with Groundwater Availability Models (GAMs) or historical maximum pumpage estimates. 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 anticipated build-out of their "purple pipe" project.

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 (14) than in any of the other planning regions.

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 (Plateau), Rustler, Marathon, and Davis Mountains 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.

El Paso 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. The supply from the direct reuse program is expected to increase from 5,000 acre-feet per year in 2000 to over 23,000 acre-feet per year by 2060.

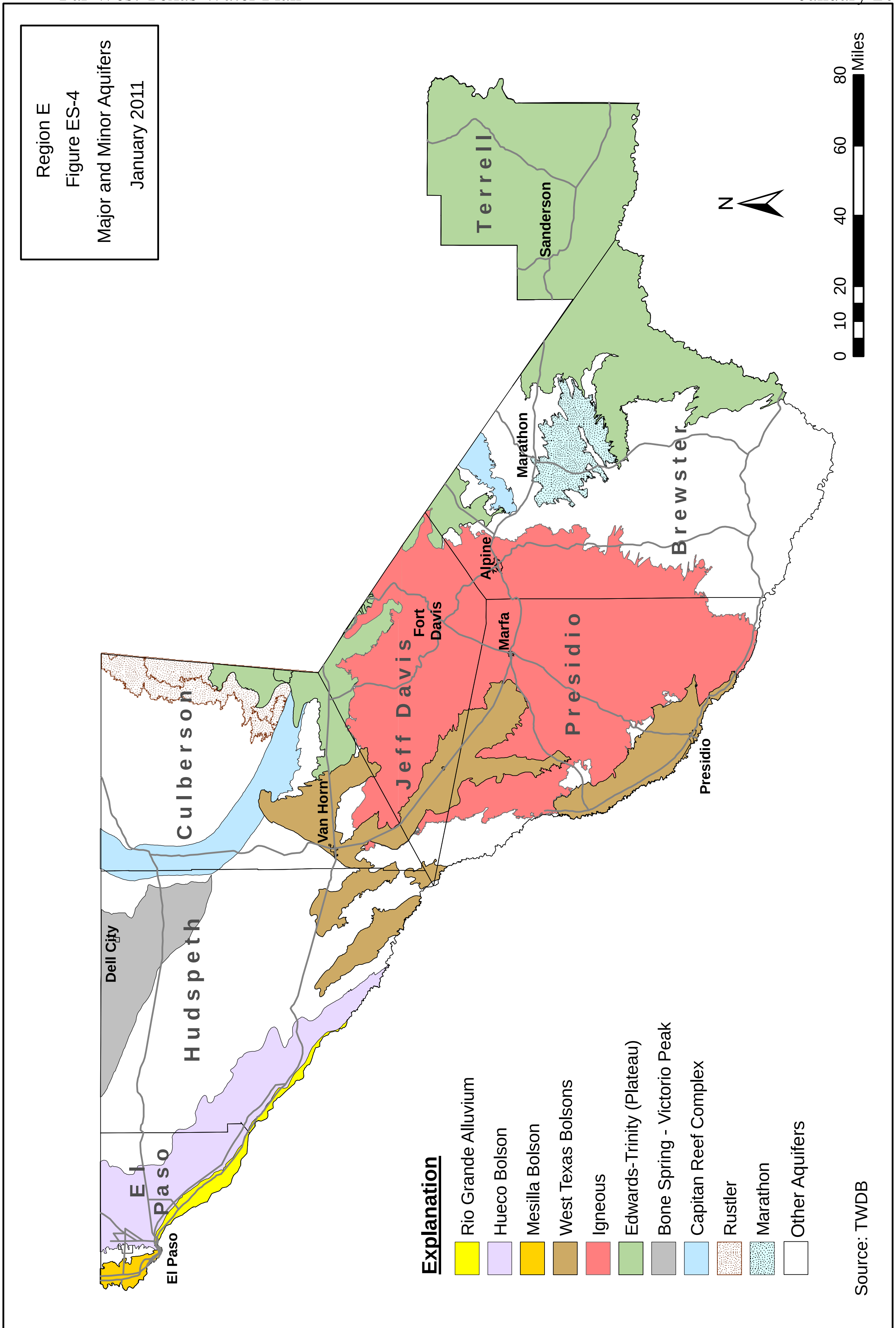

FIGURE ES-4. MAJOR AND MINOR AQUIFERS OF TEXAS

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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 18^{th} and 19^{th} centuries, locations of transportation routes including supply and stage coach lines, 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.

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 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 represents 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, and for irrigation supply use in El Paso and Hudspeth Counties.

Water supply strategy recommendations intended to meet the deficits are made for those water use groups that have projected water supply shortages. In the development of water management strategies, exi
sting 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 resources
- Impact to natural resources
- Recreational impacts

To adequately consider the unique challenges faced by municipal and industrial water users in El Paso County, an integrated approach was used to establish a feasible strategy capable of identifying sufficient future supplies to meet the needs of El Paso Water Utilities, the largest wholesale water provider in the county. Six separate approaches were considered that combined various potential surface water and groundwater sources at variable supply rates and times of implementation. The FWTWPG compared the six integrated strategies and selected the strategy termed the *"Balanced Approach with Moderate Increase in Surface Water"*, which is composed of the following elements:

- Increased conservation
- Increased reclaimed water reuse
- Recharge of groundwater with treated surface water
- Treatment of agricultural drain water
- Increased use from the Rio Grande (developed conjunctively with local groundwater)
- 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)

The importation of groundwater from the West Texas Bolson Aquifers in the vicinity of Van Horn and Valentine (Culberson, Jeff Davis and Presidio Counties) was evaluated under other integrated strategies, but it is not part of the preferred strategy.

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 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. 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 and Hudspeth Counties.

The total estimated capital cost to develop all the recommended strategies in this Plan is $842,099,633.

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 was 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. Primary and secondary safe drinking water standards are the key parameters of water quality identified by the FWTWPG as important to the use of the water resource.

A groundwater quality database using water quality analyses from the TWDB groundwater database was established to characterize the primary aquifers in the Region. 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. Surface water is also more susceptible to biological and petrochemical contamination. Treatment cost to prepare surface water for municipal distribution is generally much greater than cost for groundwater sources, although desalination of brackish groundwater may be similar.

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.

Within Far West Texas, specific water quality issues include the presence of arsenic and alpha radiation in some groundwater supplies, water quality deterioration in the Bone Spring-Victorio Peak Aquifer, general salinity problems, and the positive impact of brackish groundwater use as a drinking water source. The implementation of recommended water management strategies is not expected to impact the natural water quality of water sources beyond current conditions.

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, improve the efficiency in the use of water, or increase the recycling or reuse of water so that a water supply is made available for future or alternative uses. Water conservation and drought contingency planning implemented by municipalities, water providers, and other water users supersede recommendations in this plan 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. Water conservation plans of three entities in Far West Texas that meet this criteria are included in this Plan. These entities include the El Paso Water Utilities, the El Paso County Water Improvement District No.1, and the Hudspeth County Conservation and Reclamation District No.1.

El Paso Water Utilities is the largest supplier of municipal water in Far West Texas, supplying approximately 72 percent of all municipal needs in 2010. The City of El Paso through the El Paso Water Utilities has been implementing an aggressive water conservation program for the past 13 years and has reduced the per capita demand from 200 gpcd in 1990 to 139 gpcd in 2004. 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 management and drought contingency plans provided to the planning group by 22 public water suppliers and two 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. Five 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

PROTECTION OF WATER, AGRICULTURAL, AND NATURAL RESOURCES

The long-term protection of the Region's water resources, agricultural resources, and natural resources is an important component of this *2011 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. Groundwater availability estimates were based on acceptable levels of water-level decline or historical maximum pumping estimates. Where available, groundwater availability models (GAMs) were used as a tool to view various withdrawal rates in terms of water-level impacts. 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 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, the drought management practices will extend supplies over the stress period, and the land management practices will potentially increase aquifer recharge.

Agriculture in Far West Texas 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. 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.

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 *2011 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.

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 recommendations for the designation of ecologically unique river and stream segments in their adopted regional water plan. 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" the following 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 and the Trans Pecos Water Trust. New to this 2011 Plan is the recommendation of a segment of Alamito Creek in Presidio County that is owned and managed by the Trans Pecos Water Trust.

- 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)

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 *2011 Far West Texas Water Plan* does not recommend any watercourse for designation as "Unique Sites for Reservoir Construction."

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CHAPTER 1

FAR WEST TEXAS DESCRIPTION

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1.1 INTRODUCTION

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 2006, the second round of regional water planning was concluded with the adoption of the 2006 *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 Plan put forth in this document is not a new plan, but rather an evolutionary modification of the preceding Plan. Only those parts of the original Plan that require updating, and there are many, have been revised.

The purpose of the *2011 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.

1.2 PLANNING PROCESS

The *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. 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.

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. 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 2011 Regional Water Plan has no impact on navigation on these surface water courses.

The availability of groundwater during drought-of-record conditions is based on an annual quantity of water that can be withdrawn from each aquifer that results in no more than an acceptable level of water-level decline over the 50-year planning period. Chapter 3 contains a detailed analysis of water supply availability in the Region.

Since the completion of the *2006 Far West Texas Water Plan*, a number of changed conditions have occurred in the Region which warrant this 2011 updated water plan; however, the year-2000 census continues to be the 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. These computer simulation models were used in the current planning process and provided a more realistic analysis of possible water supply source conditions.

A recent re-evaluation of groundwater availability in the Hueco Bolson Aquifer has a major influence on total supply source availability for entities in El Paso County. In the original (2001) Regional Water Plan, fresh water in the aquifer was anticipated to be depleted by the year 2030, which resulted in an unmet supply need following 2030 for eight communities, including the City of El Paso. Through the use of a recently completed Hueco Bolson Aquifer simulation model, El Paso Water Utilities was able to develop a conjunctive use management plan that utilizes groundwater from the Hueco Bolson Aquifer in a sustainable manner.

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.

A number of feasibility studies have been performed in areas where groundwater exportation is being considered. These reports were used when considering supply availability and resource impacts. Feasibility and construction design reports for the El Paso-Fort Bliss Joint Desalination Project (Kay Bailey Hutchison Desalination Facility) were also used in the development of this Water Plan. Also of informational importance to the Water Planning Group 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 Far West Texas Water Planning Group (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. 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 deficit strategies (Chapter 4), water quality impacts (Chapter 5), and recommendations (Chapter 8).

1.2.1 Groundwater Management Areas

In recent sessions, the Texas Legislature has redefined the manner in which groundwater is to be managed (http://www.twdb.state.tx.us/GwRD/GMA/gmahome.htm). 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 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.state.tx.us/mapping/index.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 are a description of the aquifers at some time in the future. This description is a precursor to developing a volumetric number called *managed available groundwater*. The TWDB is responsible for providing each groundwater conservation district and regional water planning group, located wholly or partly in the management area, with *managed available groundwater*. Once the *managed available groundwater* is determined, the districts begin issuing groundwater withdrawal permits to support the desired future condition of the aquifer up to the total amount of *managed available groundwater*. These permits express *desired future conditions* by only allowing withdrawals that will support the conditions established by the groundwater management area. Regional water plans must also incorporate the *managed available groundwater* 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

As of October 1, 2009, *desired future conditions* have not been adopted for any aquifers in these GMAs. It is anticipated that the 2016 Far West Texas Water Plan will include a significant revision to all groundwater source availability estimates based on *managed available groundwater* volumes generated from the GMA process.

1.2.2 Interim Planning Projects

The first half of the current planning period was involved with the completion of the following four interim projects designated by the FWTWPG to evaluate specific water supply availability and management issues.

- Evaluation of Irrigation Efficiency Strategies for Far West Texas: Feasibility, Water Savings and Cost Considerations
- Conceptual Evaluation of Surface Water Storage in El Paso County
- Groundwater Data Acquisition in Far West Texas
- Water Conservation Conference for Far West Texas Water Plan Region E

Summaries and conclusions of the projects are provided as Appendices 1A through 1D, and the full reports can be accessed on the Rio Grande Council of Governments website at http://www.riocog.org/EnvSvcs/FWTWPG/publishe.htm. Information gained from these projects is also incorporated in specific water-supply management strategies discussed in Chapter 4.

1.2.3 Definitions

The following definitions are included in Chapter 1 to provide the reader with a reference source for selected technical terms found in this report.

Acre-Foot - The volume of water required to cover one acre to a depth of one foot; 325,851 gallons.

Aquifer - One or more formations that contain sufficient saturated permeable material to conduct groundwater and to yield economically significant quantities of water to wells and springs.

Arid climate - A term used to describe a climate characterized by dryness, variously defined as rainfall insufficient for plant life or for crops without irrigation; less than 10 inches of annual rainfall; or a higher evaporation rate than a precipitation rate. Compare with "semiarid."

Bolson - A term used, especially in the southwestern U.S., to describe flat, saucer-shaped, alluvium-floored basins that are surrounded by mountains and in which drainage is internal. Bolson aquifer or basin aquifer implies the water-saturated portion of the sediments filling the bolson or basin.

Drought - A period of abnormally dry weather of sufficient length to cause serious hydrologic imbalance as indicated by crop damage, water-supply shortage, etc.

Drought-of-record - A drought period with the greatest hydrologic/agricultural/ public water-supply impact recorded in a region.

Forbearance contract - A contract in which a landowner agrees to forego delivery of Rio Grande Project Water.

Geologic formation - The basic stratigraphic unit in the classification of rocks, consisting of a body of rock generally characterized by some degree of compositional homogeneity, by a prevailingly but not necessarily tabular shape over its areal extent, and by mapability at Earth's surface or traceability in the subsurface.

Hydrogeology - The branch of the science of geology that deals with subsurface waters and related geologic aspects of surface waters.

Irrigation demand - The quantity of water needed on a field to economically grow crops.

Reuse - The process of recapturing water following its initial use and making it available for additional uses. The process generally requires a level of treatment appropriate for its next intended use.

Riparian - Pertaining to being situated on the bank of a body of water, especially of a watercourse such as a river; situated on or abutting a stream bank.

Semiarid climate - A climate in which there is slightly more precipitation (10 to 20 inches) than in an arid climate (less than 10 inches), and in which grasses are the characteristic vegetation.

Storage - The volume of water contained within the pore space of an aquifer. Recoverable storage is the percentage of water in storage that can be economically withdrawn from an aquifer.

Water budget - An accounting of the inflow to, outflow from, and storage in a hydrologic unit such as a drainage basin, aquifer, soil zone, lake, or reservoir. The relationship between evaporation, precipitation, runoff, and the change in water storage.

Water demand - The total volume of water required to meet the needs of a water-use category.

Water-supply availability - The volume of water capable of being withdrawn or diverted from specific sources of supply that results in an acceptable impact on the water source and its primary users.

1.2.4 Acronyms

BMP - Best Management Practice

EBID - Elephant Butte Irrigation District

EDAP - Economically Distressed Area Program

EPA - United States Environmental Protection Agency

EPCWCID#4 - El Paso County Water Control and Improvement District #4

EPCWID#1 - El Paso County Water Improvement District #1

EPWU - El Paso Water Utilities

FDWSC - Fort Davis Water Supply Corporation

FWTWPG – Far West Texas Water Planning Group

gpm - Gallons Per Minute

GAM - Groundwater Availability Model

GIS - Geographic Information System

HB - House Bill

HCCRD#1 – Hudspeth County Conservation and Reclamation District #1

HCUWCD#1 - Hudspeth County Underground Water Conservation District #1

IBWC/CILA - International Boundary and Water Commission/Comisión Internacional de Límites y Aquas

LVWD - Lower Valley Water District

MCL - Maximum Contaminant Levels

mg/l - Milligrams Per Liter

MGD - Million Gallons Per Day

M & I - Municipal and Industrial

MUD - Municipal Utility District

NRCS - Natural Resource Conservation Service

RGP - Rio Grande Project

PGMA - Priority Groundwater Management Area

SB - Senate Bill

TAC - Texas Administrative Code

TCEQ - Texas Commission on Environmental Quality

TDA - Texas Department of Agriculture

TNRCC - Texas Natural Resource Conservation Commission

TPWD - Texas Parks and Wildlife Department

TPWT - Trans Pecos Water Trust

TSSWCB - Texas State Soil and Water Conservation Board

TWC - Texas Water Commission

TWDB - Texas Water Development Board

TDS - Total Dissolved Solids

USBR - United States Bureau of Reclamation

USFWS - United States Fish and Wildlife Service

USGS - United States Geological Survey

WAM - Water Availability Model

WCS - Water Supply Corporation

WCID - Water Conservation and Improvement District

WERC - Originally the Waste-management, Education and Research Consortium; Now - A Consortium for Environmental Education and Technology Development

WUG - Water User Group

1.3 REGIONAL GEOGRAPHIC SETTING

1.3.1 Far West Texas

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 Republic of Mexico, and on the east by the Pecos River; and incorporates the counties of Brewster, Culberson, El Paso, Hudspeth, Jeff Davis, Presidio and Terrell (Figure 1-1). 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.

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 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).

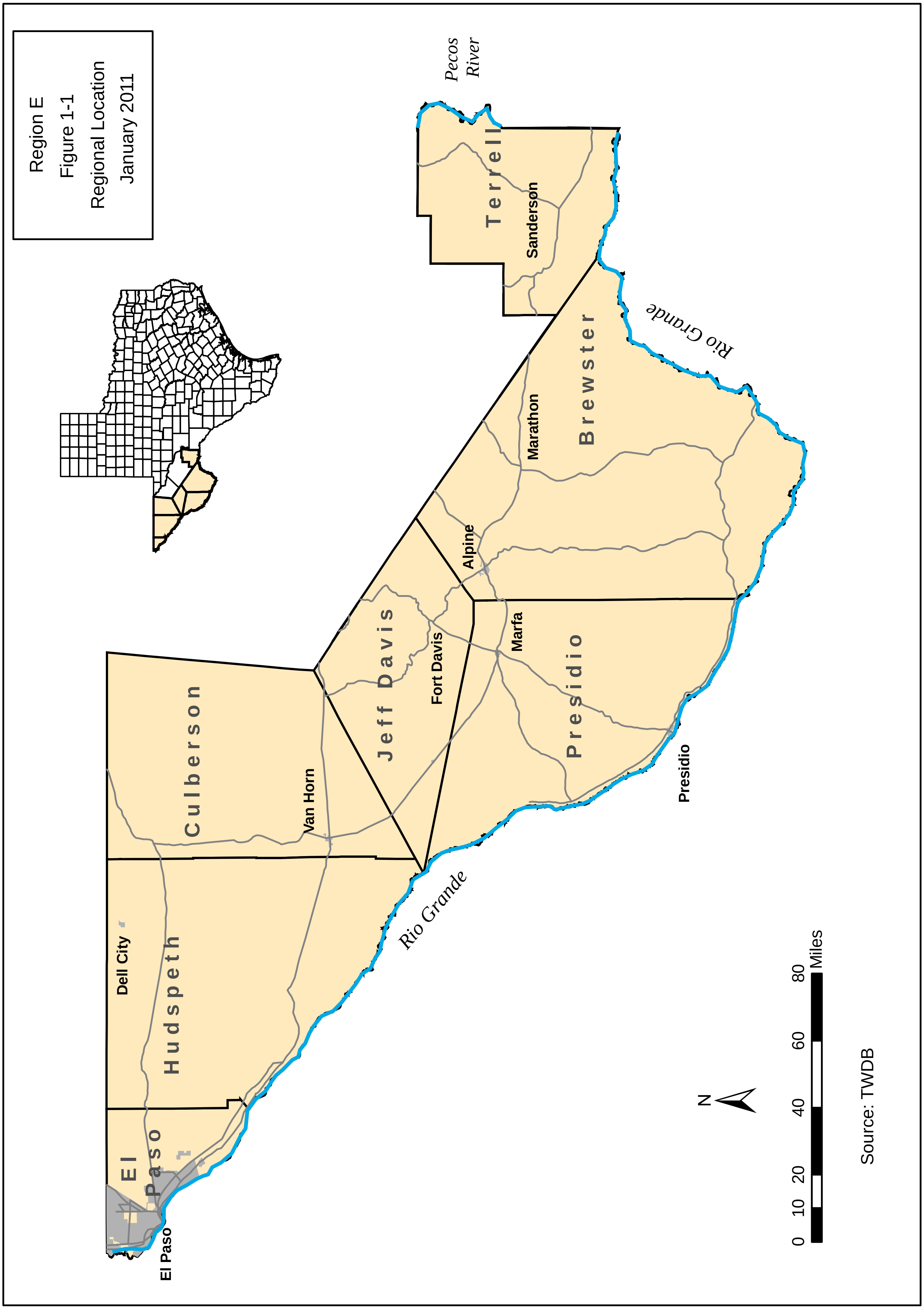

FIGURE 1-1. LOCATION OF FAR WEST TEXAS PLANNING REGION

LBG-GUYTON ASSOCIATES

1.3.2 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 1-2). 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 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.

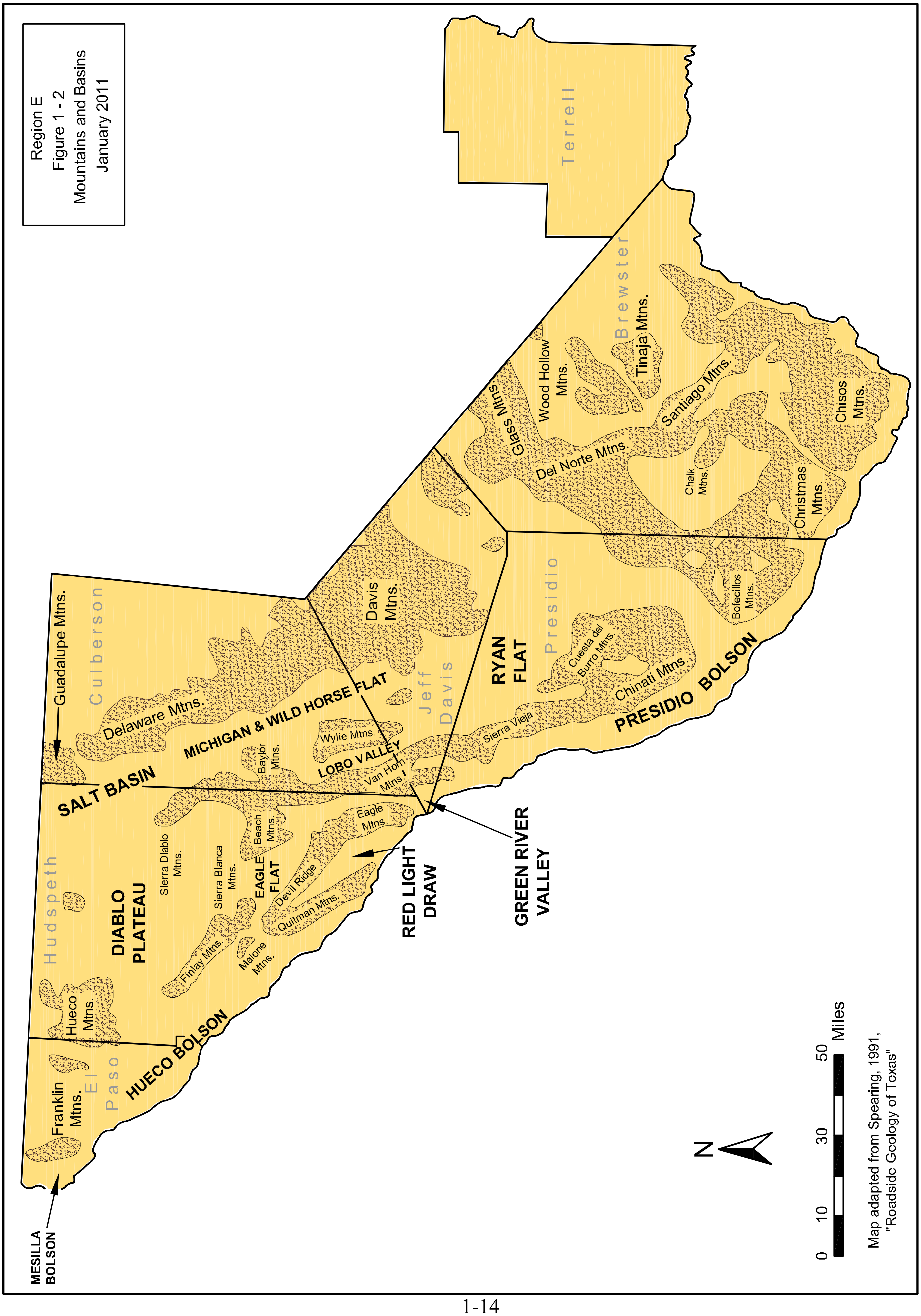

FIGURE 1-2. MOUNTAINS AND BASINS

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 intermontane basins from which there is no external drainage (e.g., Eagle Flat, Ryan Flat, Michigan Flat, 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 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. 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.

1.3.3 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 (Figure 1-3). In the year 2010, approximately 97 percent (833,640) of the Region's 863,190 residents are projected to reside in El Paso County, where the population density is 760 persons per square mile. 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-2010 projected population of 637,481. This is 76 percent of the total population of El Paso County and 74 percent of the Region's total population.

The year-2010 projected populations of cities in the six rural counties are as follows: Alpine, Brewster County (6,320); Van Horn, Culberson County (2,743); Sierra Blanca, Hudspeth County (608); Fort Davis, Jeff Davis County (1,700); Marfa, Presidio County (2,585); Presidio, Presidio County (5,360); Sanderson, Terrell County (921). 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 68,006, or eight percent of the total Regional population. The current and projected population growth in Far West Texas is further discussed in Chapter 2.

The greatest increase to population in the Region is associated with the Fort Bliss Military Base. According to information provided by Fort Bliss, there are now 19,300 soldiers stationed at the base, and by 2018, current plans call for having 33,470 soldiers stationed at the base. There are now 20,820 people living on the base, and current plans call for this to increase to 27,630 by 2018. Other soldiers and their dependents will live off the base. The military population expansion creates an increased water demand in the City of El Paso geographic area. This current 2011 Plan projects an increase of approximately 4,000 acre-feet of water use by Fort Bliss in the year 2020 over what was projected in the previous 2006 Plan. The new El Paso-Fort Bliss Kay Bailey Hutchison Desalination Facility will generate a new supply of water to assist in meeting this increased need.

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 4A):

> *The Region E (Far West Texas) economy generates about $33 billion in gross state product for Texas ($30 billion worth of income and $3 billion in business taxes), and supports 377,702 jobs. Agriculture and manufacturing (particularly petroleum refining, copper smelting and automotive parts) are the primary base economic sectors. Municipal sectors also generate substantial amounts of income – about $25 billion per year. While municipal sectors are the largest employer and source of income, many businesses that make up the municipal category such as restaurants and retail stores are non-basic industries meaning they exist to provide services to people who work would in base industries such as manufacturing, agriculture and mining. In other words, without base industries such agriculture, many municipal jobs in the region would not exist.*

The Tornillo-Guadalupe New International Bridge border crossing in El Paso County is expected to be completed in 2012 and will replace the existing Fabens-Caseta International Bridge. The crossing, capable of handling modern day commercial, automobile and pedestrian traffic, will support the expansion of trade and economic growth on both sides of the border. In the El Paso area the new crossing will allow 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 will also allow expansion of employment opportunities along IH-10 near the intersection of traffic from Tornillo and Fabens. In Mexico, the project will provide an additional crossing that will accommodate 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 now goes through downtown El Paso and Juarez will be 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 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. An analysis of Railroad Commission of Texas (RCT) files found that in all Far West Texas counties except Terrell, water use projections for the industry by the TWDB were relatively accurate. However, an RCT review of oil and gas activity in Terrell County reveals that 460 wells were drilled in the county over a 10-year span from 1999 through 2008. Water-use calculations for these 460 wells indicate that the volume of water used exceeds TWDB projections by approximately 125 acre-feet per year.

An interesting 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. To recognize the modest increases in water use, this plan has increase projected irrigation water demands in Jeff Davis County by 15 acre-feet per year, and in Presidio County by 236 acre-feet per year.

Following the 2006 Far West Texas Water Plan submittal, there appeared to be the potential for increasing water needs in the Region as generated by an anticipated 1,000-bed expansion of the prison in Sierra Blanca and the construction of a biodiesel plant in Presidio County. As of the printing of this Plan, neither of these projects has occurred.

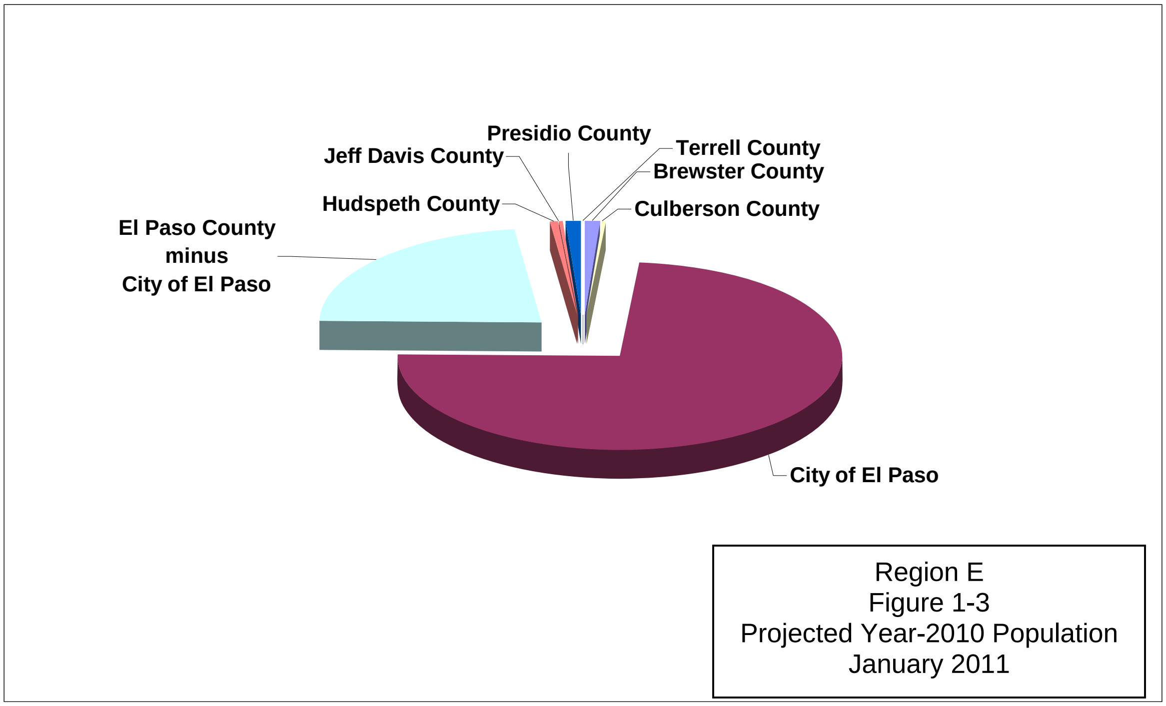

Figure 1-3. Projected Year-2010 Population by County

1.3.4 Land Use

Land use in the seven-county Region, as illustrated in Figure 1-4, is described in terms of seven categories:

- Urban (or developed)
- Cultivated agricultural
- Rangeland
- Forest
- Waterways
- 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 96 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 agricultural lands comprise the two most significant land-use areas of water consumption.

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.

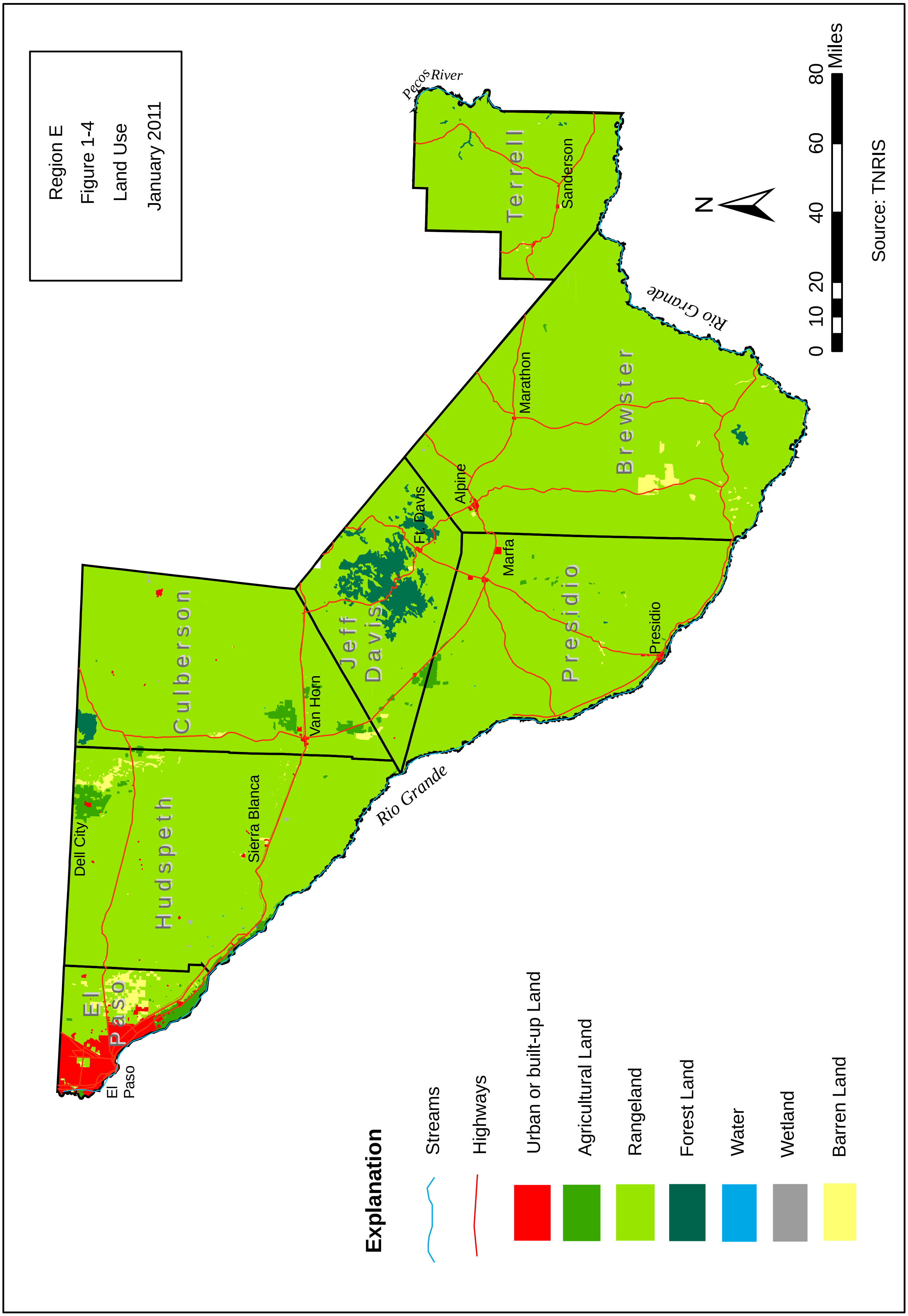

FIGURE 1-4. LAND USE

1.3.5 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 (Figures 1-5 and 1-6). 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)

Most rainfall occurs between the months of June and October, as indicated by a graph of average monthly rainfall for selected stations (Figure 1-7). Rainfall during the spring and summer months is dominated by widely scattered thunderstorms. Because of the convective nature of thunderstorms, the amount of spring and summer precipitation in the Region increases with elevation.

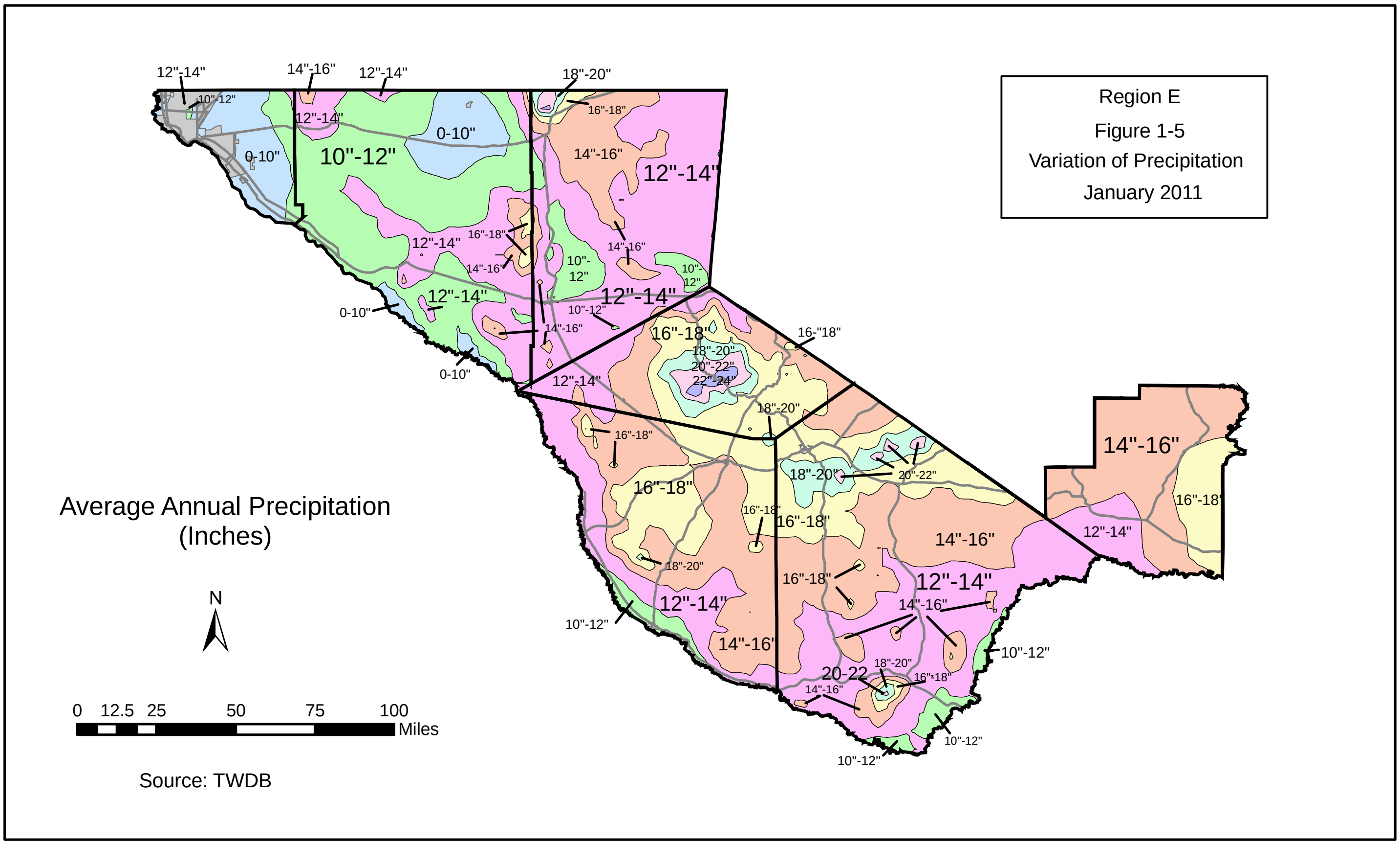

FIGURE 1-5. VARIATION OF PRECIPITATION, 1961-1990

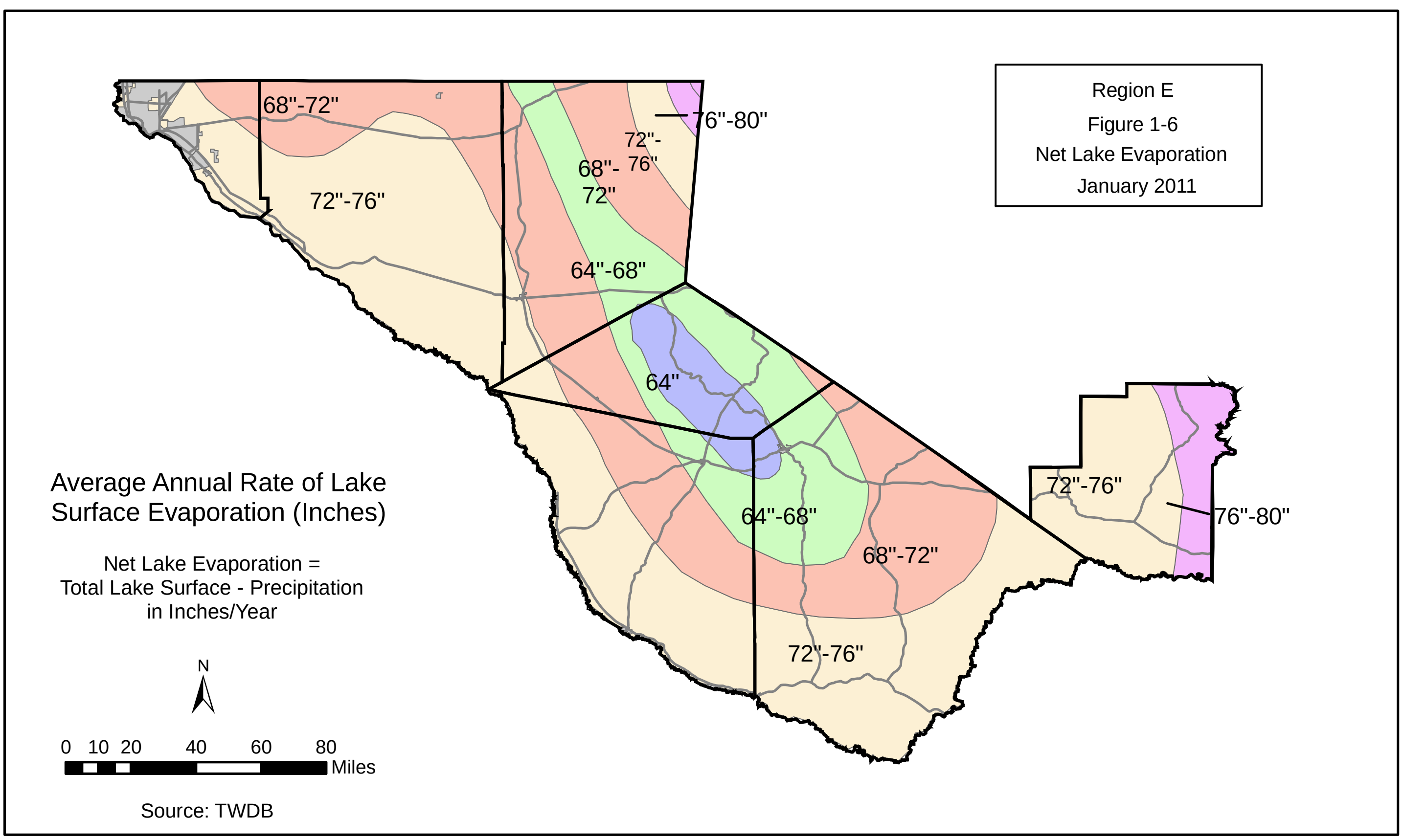

FIGURE 1-6. NET LAKE SURFACE EVAPORATION, 1940-1978

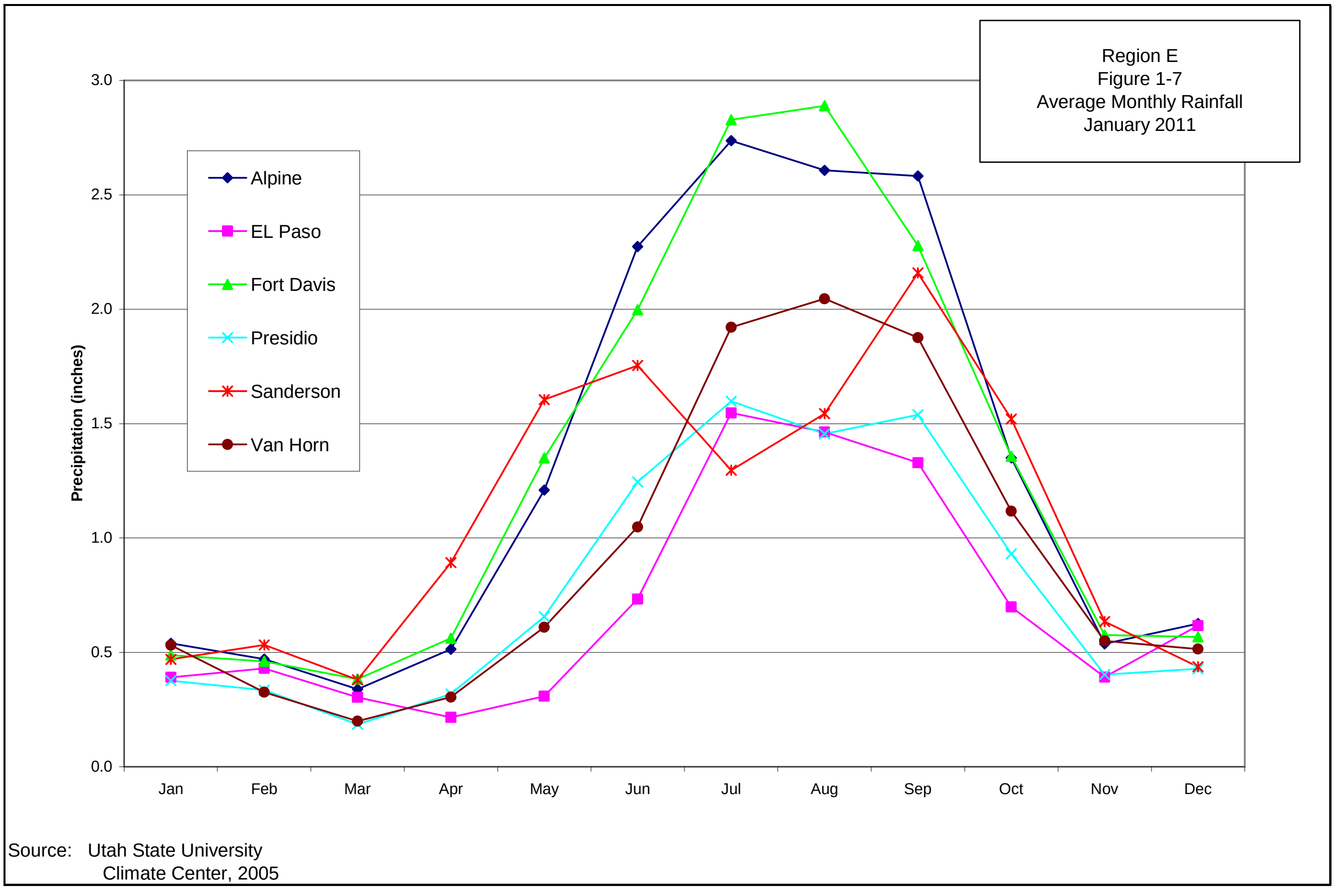

Figure 1-7. Average Monthly Rainfall for Selected Stations

Drought conditions are assumed in the planning process to insure that adequate infrastructure and planning is in place under severe water shortage conditions. Drought is generally defined as a period of abnormally dry weather of sufficient length to cause a serious hydrologic imbalance, which may be observed in any of the following conditions:

- Lower precipitation in key watersheds
- Extended periods of high temperature
- Higher levels of evapotranspiration
- Reduced runoff and snow melt
- Stressed plants and grasses
- Reduced stream flow and spring flow
- Lower reservoir and groundwater levels
- Increased regional water demand

Drought can also be defined in the following operational definitions:

Meteorologic drought is defined as 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 defined as 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 meteorological drought, the occurrence of meteorological 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 (Figure 1-8). 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, have been experiencing drought conditions for much of the past 14 years, with only 1997, 2005 and 2008 experiencing above average spring runoff into Elephant Butte reservoir. According to the AgriLIFE Research "Drought Watch on the Rio Grande" – June 16, 2010 press release, water storage in the two Rio Grande Project reservoirs, Elephant Butte and Caballo, is currently at 29 percent of the total combined reservoirs' capacity. The lowest 2010 water storage level at

Elephant Butte is projected to be about 367,000 acre-feet (17 percent of full) around mid-October.

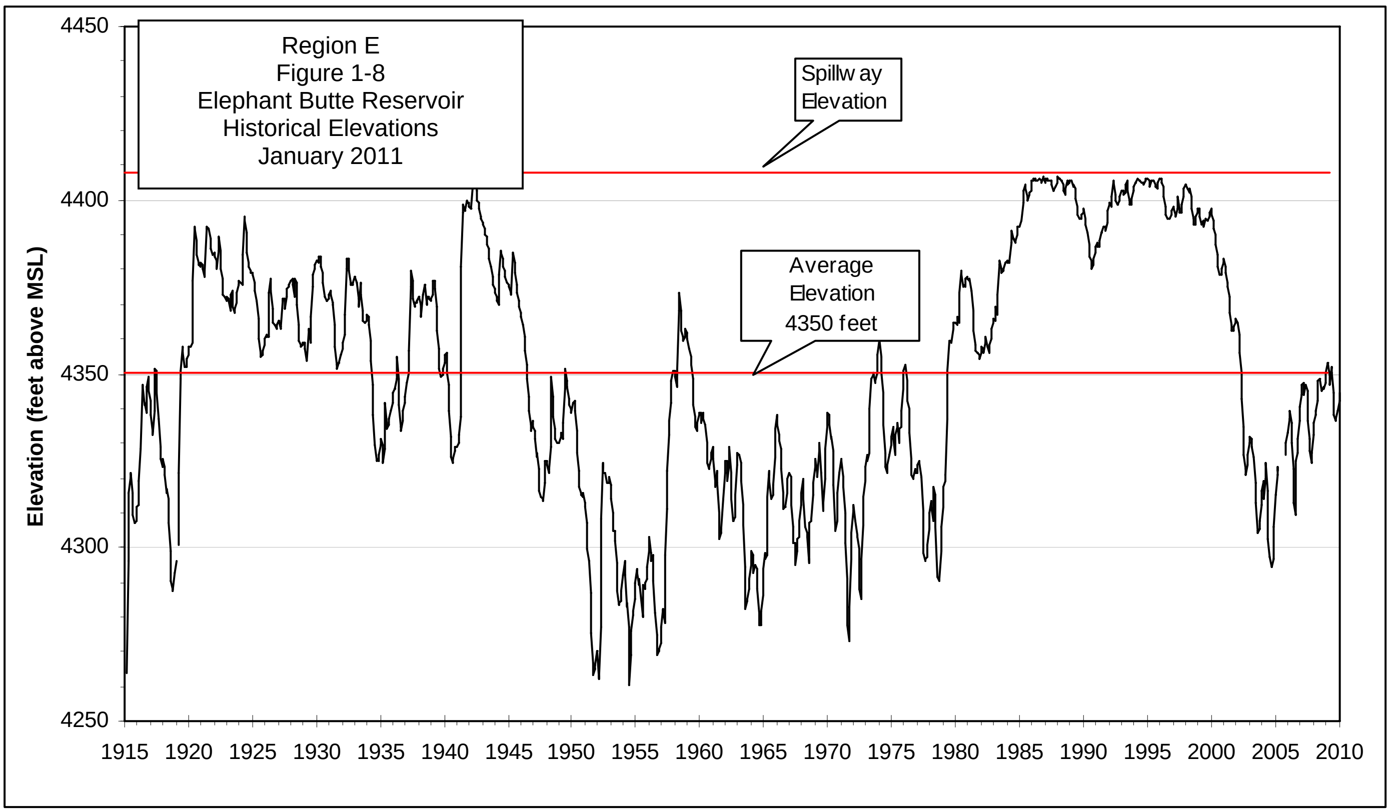

Figure 1-8. Historical End-of-Month Elevation for Elephant Butte Reservoir

1.3.6 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.

1.3.7 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.

1.3.8 Natural Resources

Far West Texas boasts the highest and most scenic desert communities in Texas. The natural resources of the Region include the groundwater and surface water sources described in Section 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. Species listed in the counties of Far West Texas were previously provided in the Chapter 1 appendices of the 2006 Far West Texas Water Plan; however, the TPWD suggests that due to continuing updates that the reader 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. Appendix 1E describes a number of "major springs", while "ecologically unique river and stream segments" are described in Chapter 8.

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 4 of this plan include an evaluation of each strategy's potential impact on the environment and natural resources.

1.4 REGIONAL WATER DEMAND

1.4.1 Major Demand Centers

Total projected year-2010 water consumptive use in Far West Texas is 648,126 acre-feet. The largest category of use is irrigation (499,092 acre-feet), followed by municipalities (129,476 acre-feet), manufacturing (9,187 acre-feet), livestock (4,843 acre-feet), steam-electric cooling (3,131 acre-feet), and mining (2,397 acre-feet). The significance of irrigation as a category of demand is further underscored by the accompanying pie chart (Figure 1-9), which shows that 77 percent of water use is by the agricultural sector in support of irrigation. Twenty percent is used by municipalities, and the remaining 3 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.

1.4.2 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 2010 is 4,843 acre-feet. The single largest area of livestock demand is in El Paso County, where 1,742 acre-feet (36 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 2010 ranged from a high of 707 acre-feet in Brewster County to a low of 307 acre-feet in Terrell County. The lower numbers associated with the rural counties may be a reflection of the lack of concentrated dairy farms outside of El Paso County.

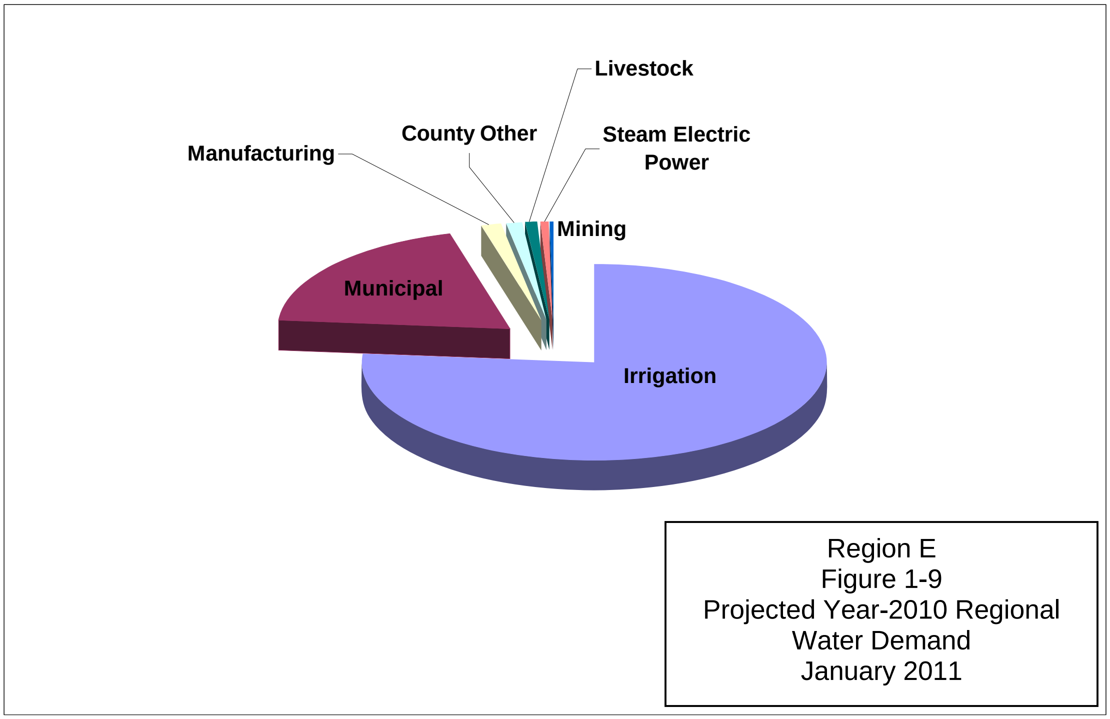

Figure 1-9. Projected Year-2010 Regional Water Demand by Water Use Category

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 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. 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 2010 is 499,092 acre-feet. El Paso and Hudspeth Counties accounted for the greatest amount of irrigation with 247,111 and 182,627 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 90 percent of total irrigation water use in the Region. Most of the remaining 10 percent of irrigation demand is centered in Culberson and Presidio Counties, where 46,759 and 25,156 acre-feet, respectively, were used in 2010 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 approximately 13,000 acres of land within the District with water rights.

Despite the relatively small area of irrigated land, the annual value of crop production is as much as $141 million in the Region, generating an agricultural income of $88 million (2006 data reported in the TWDB Socioeconomic Analysis).

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 63,000 acre-feet or less annually. 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.

1.4.3 Municipal

The municipal category of demand consists of both residential and commercial water uses. Commercial water consumption includes business establishments, public offices, and institutions, but does not include industrial water use. Residential and commercial uses are categorized together because they are similar types of uses, i.e.; they both use water primarily for drinking, cleaning, sanitation, air conditioning, and landscape watering. Total projected municipal water demand in the seven counties in the year 2010 is 129,476 acre-feet.

The City of El Paso, with a projected water use of 92,829 acre-feet in the year 2010, represents 72 percent of the total municipal 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 water use in El Paso County (123,162 acre-feet in 2010), which includes the City of El Paso, other communities, and rural domestic supply, represents 95 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.

1.4.4 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 (2006), 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 (2006–2011). 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

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 2008, the District provided 59,032 acre-feet to EPWU. During the drought years 2003 and 2004, EPWU only received 24,992 and 31,495 acre-feet respectively.

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, as much as 8,407 acre-feet were sold in 2004 to numerous other public supply, manufacturing, and industrial entities. In 2002, the highest amount of water sold on record by EPWU was 8,989 acre-feet. The Lower Valley Water District is a significant supplier of water to other entities and receives all of its supply from EPWU.

EPWU has consistently decreased its groundwater dependence on the Hueco Bolson Aquifer. Since 2000, pumping from the aquifer has been reduced from 59,410 acre-feet to 26,204 acre-feet in 2008.

1.4.5 Industrial, Manufacturing, Electric Power Generation, and Mining

Industrial and manufacturing companies represent a significant component of the economy of Far West Texas. Most of these businesses, however, are located in El Paso County. The degree to which these businesses are concentrated in El Paso County is shown by the fact that all but 6 acre-feet of the 9,187 acre-feet of water used in the Region by the manufacturing and industrial sector in the year 2010 was 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. The mining sector accounts for the smallest area of demand, with 2,397 acre-feet of projected total use in the Region in 2010.

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. 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 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.

1.4.6 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 and especially in Chapters 2, 3, 4 and 8.

1.5 WATER SUPPLY SOURCES

1.5.1 Surface Water

1.5.1.1 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 (Figure 1-10). 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.

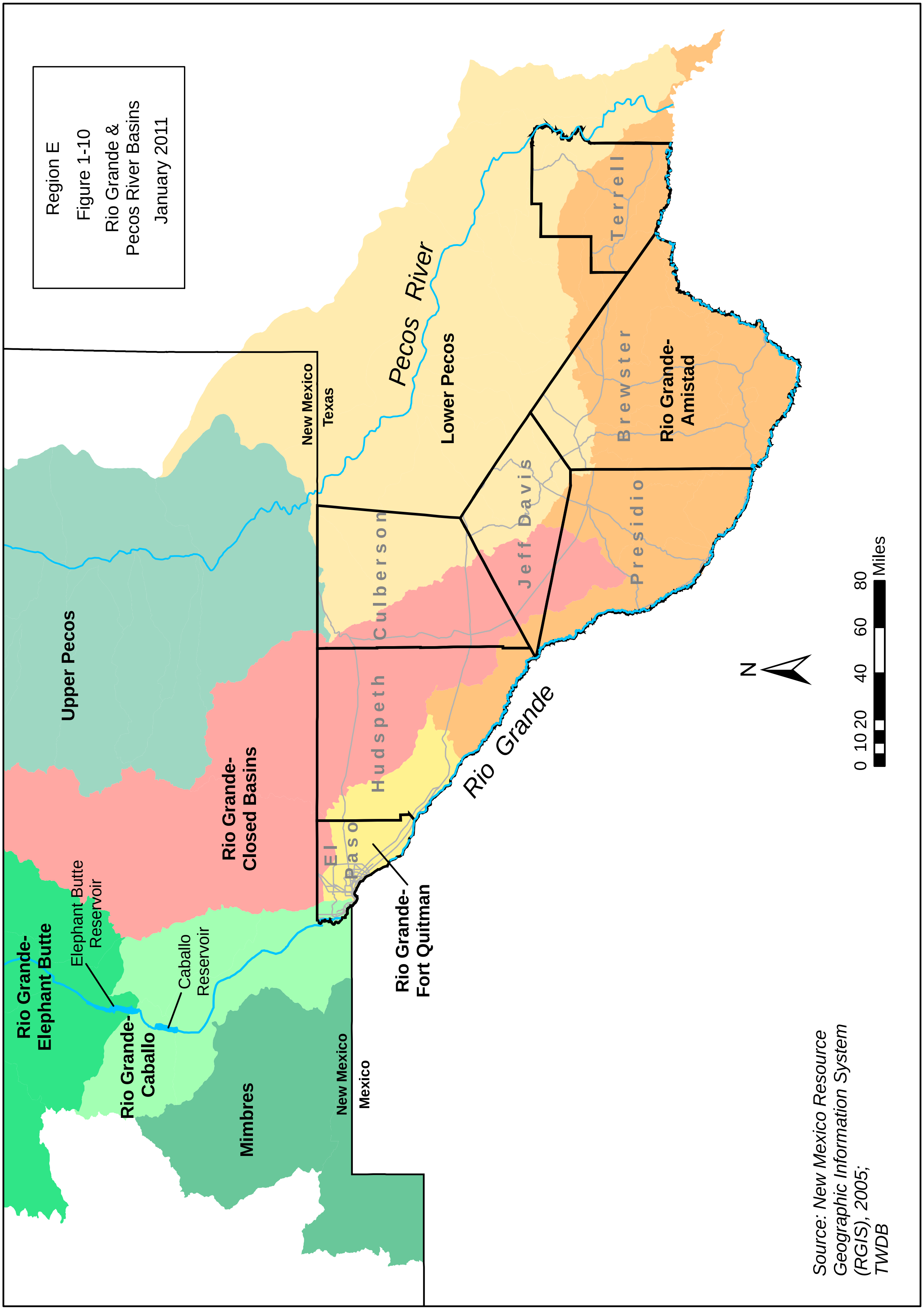

FIGURE 1-10. RIO GRANDE AND PECOS RIVER BASINS AND SUB-BASINS ON THE U.S. SIDE OF THE INTERNATIONAL BORDER

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1.5.1.2 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 1-10). 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.

1.5.1.3 Ecologically Unique River and Stream Segments

As a part of the planning process, regional planning groups may include <u>recommendations</u> of ecologically unique river and stream segments in their adopted regional water plans (31 TAC 357.8). The Texas Legislature <u>may 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 FWTWPG chooses to respect the privacy of private lands and therefore recommends as "Ecologically Unique River and Stream Segments" (Figure 1-11) 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 and the Trans Pecos Water Trust. These stream and river segments are described in Chapter 8.

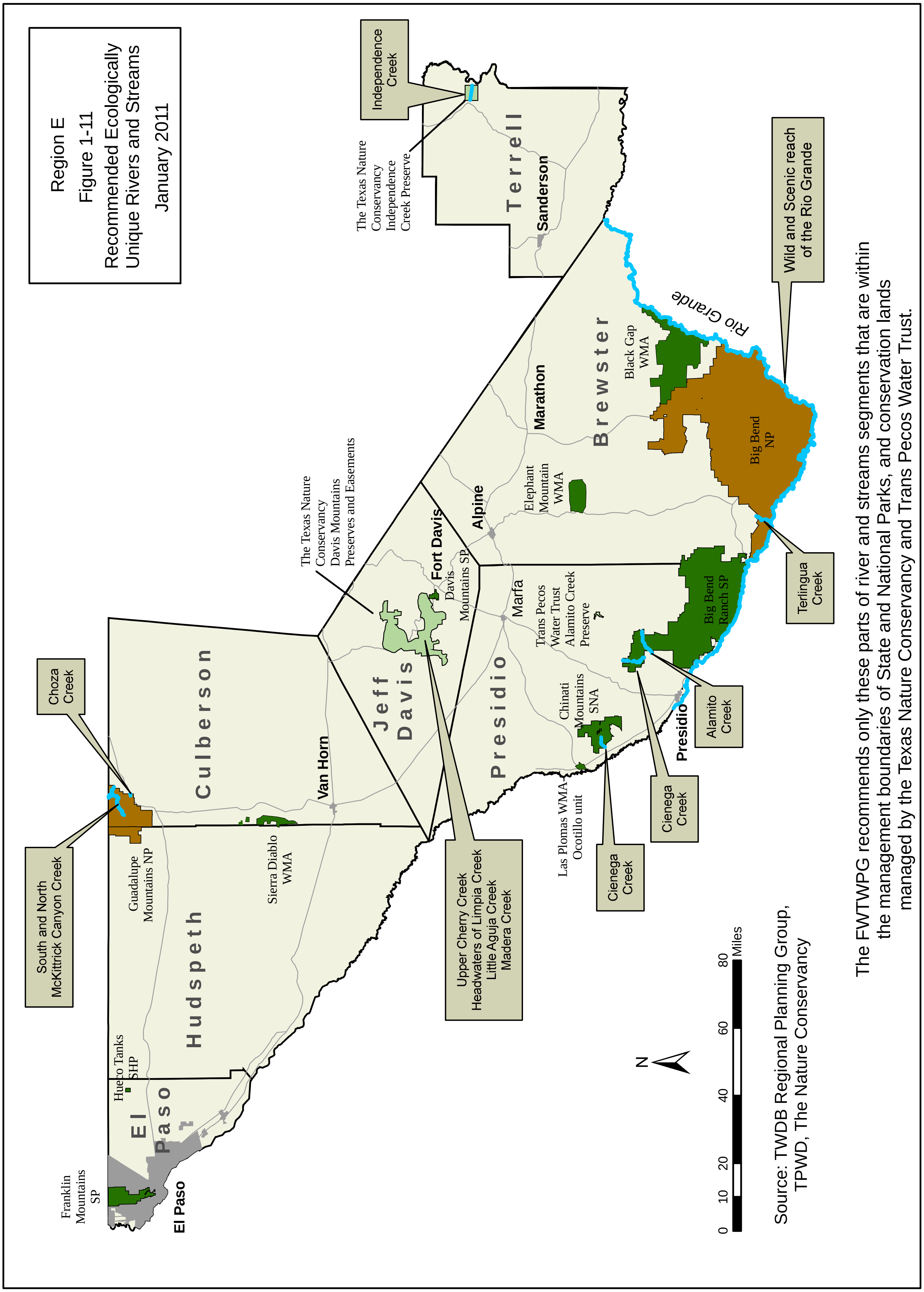

FIGURE 1-11. RECOMMENDED ECOLOGICALLY UNIQUE RIVER AND STREAM SEGMENTS

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1.5.2 Groundwater

Outside of the Rio Grande corridor, almost all water supply needs are met with groundwater withdrawn from numerous aquifers in the Region (Figure 1-12). 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) including geologically similar formations in South Brewster County sometimes referred to as the “Santa Elena” aquifer or “Cretaceous” aquifer
- Bone Spring-Victorio Peak
- Capitan Reef
- Davis Mountains Igneous
- Marathon
- Rustler
- West Texas Bolsons
- Rio Grande Alluvium
- Other locally recognized groundwater sources

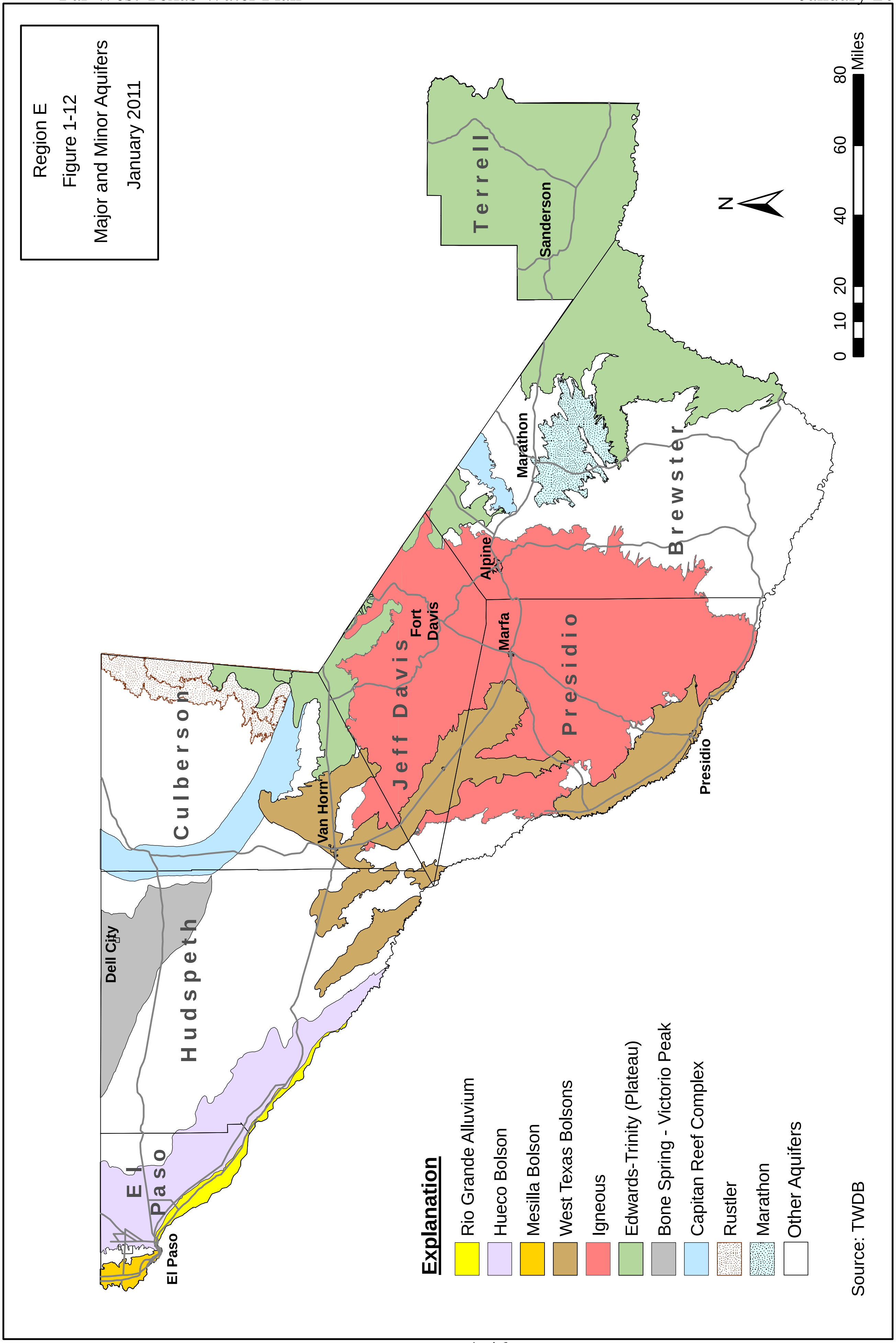

FIGURE 1-12. MAJOR AND MINOR AQUIFERS OF FAR WEST TEXAS

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1.5.2.1 Hueco Bolson Aquifer

The Hueco Bolson Aquifer extends from east of the Franklin Mountains in El Paso County southeastward into southern Hudspeth County, and is bounded on the east and north by the Hueco Mountains, the Diablo Plateau, and the Quitman Mountains. The aquifer also 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.

The Hueco Bolson Aquifer is the principal source of municipal supply for Ciudad Juarez; another groundwater source now under study is the Conejos Medanos located northwest of the city. Large-scale groundwater withdrawals, especially from municipal well fields in areas of El Paso and Ciudad Juarez, have caused significant declines in the water table.

In the original (2001) Regional Water Plan, fresh water in the Hueco Bolson Aquifer was anticipated to be depleted by the year 2030, which resulted in an unmet supply need following 2030 for eight communities, including the City of El Paso. Since that original Plan, EPWU has developed conjunctive use management strategies that utilize groundwater from the Hueco Bolson in a sustainable manner. EPWU is also actively developing a new water supply by desalinating the previously unused brackish portion of the aquifer.

1.5.2.2 Mesilla Bolson Aquifer

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. EPWU's Canutillo well field is located in the Mesilla Bolson.

1.5.2.3 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 minor 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. Consequently, water levels have remained constant or have fluctuated only in response to seasonal precipitation. The City of Sanderson in Terrell County is the only municipality in the Region that pumps water from the state designated potion of this aquifer.

1.5.2.4 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. In 2007 the TWDB (State Water Plan) significantly enlarged the designated area of the aquifer to a total of 710 square miles by extending its western and southern boundary. Water in the aquifer occurs in joints, fractures and solution cavities that have developed in the nearly 2,000 feet of limestone. Permeability is highly variable and well yields differ widely from about 150 gpm to more than 2,000 gpm.

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. Although the water table has declined since pre-irrigation development, water levels have remained relatively constant since the late 1970s. 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.

1.5.2.5 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 4*).

1.5.2.6 Davis Mountains Igneous Aquifer

The Davis Mountains Igneous Aquifer occurs in the Davis Mountains of Jeff Davis County and extends outward into Brewster and Presidio Counties. The extent of the Davis Mountains Igneous aquifer as illustrated in Figure 1-12 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. The Cities of Alpine, Fort Davis and Marfa rely on the aquifer as a source of municipal supply.

1.5.2.7 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. Groundwater occurs in numerous crevices, joints and cavities at depths ranging from 350 feet to about 900 feet, and well yields range from 10 gpm to more than 300 gpm. Many of the shallow wells in the area actually produce water from alluvial deposits that overlie rocks of the Marathon Aquifer. Groundwater in the aquifer is typically of good quality but hard.

1.5.2.8 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. Water occurs in highly permeable solution zones in dolomite, limestone and gypsum beds of the Rustler Formation. No communities in Far West Texas rely on this aquifer as large concentrations of dissolved solids render the water unsuitable for human consumption.

1.5.2.9 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 Wild Horse, Michigan, Lobo, and Ryan Flats. The upper part of the Salt Basin extending north of Wild Horse Flat contains groundwater with total dissolved solids well in excess of 3,000 mg/l. 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.

1.5.2.10 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.

1.5.2.11 Other Groundwater Resources

Also shown in Figure 1-12 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. For example, the rocks that make up the subsurface of the Diablo Plateau of central and northern Hudspeth County may in fact have significant volumes of groundwater in storage. Because relatively few exploration wells have been drilled on the Plateau, the aquifer has not been sufficiently evaluated to warrant definite conclusions regarding its status as a potential source of groundwater.

Similarly, very little hydrologic data has been collected in much of the remote areas of the rural counties in the Region. 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. Further evaluation will be needed to arrive at a better understanding of the water-resource development potential in these areas.

1.5.3 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, 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 1-13 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 1-14). These springs are discussed in detail in Appendix 1E. Many of these springs also are the primary source of flow to the "ecologically unique river and stream segments" described in Chapter 8.

- 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

1.5.4 Reuse

El Paso has nearly 40 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. The supply from the direct reuse program is expected to increase from 7,387 acre-feet per year in 2010 to over 23,000 acre-feet per year by 2060. Projected expanded use of reclaimed water by decade is listed in Table 3-1 in Chapter 3.

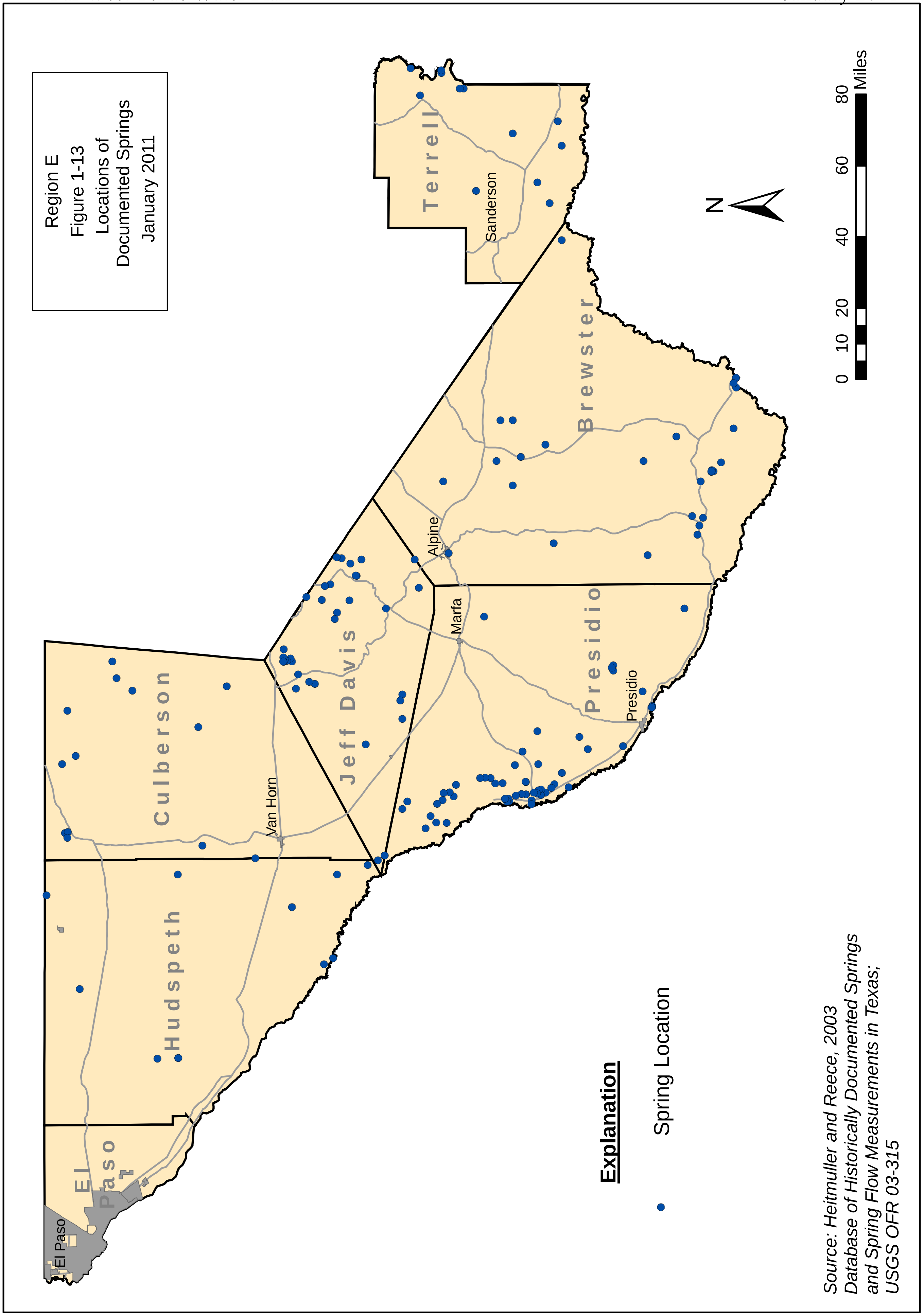

FIGURE 1-13. LOCATION OF DOCUMENTED SPRINGS

LBG-GUYTON ASSOCIATES

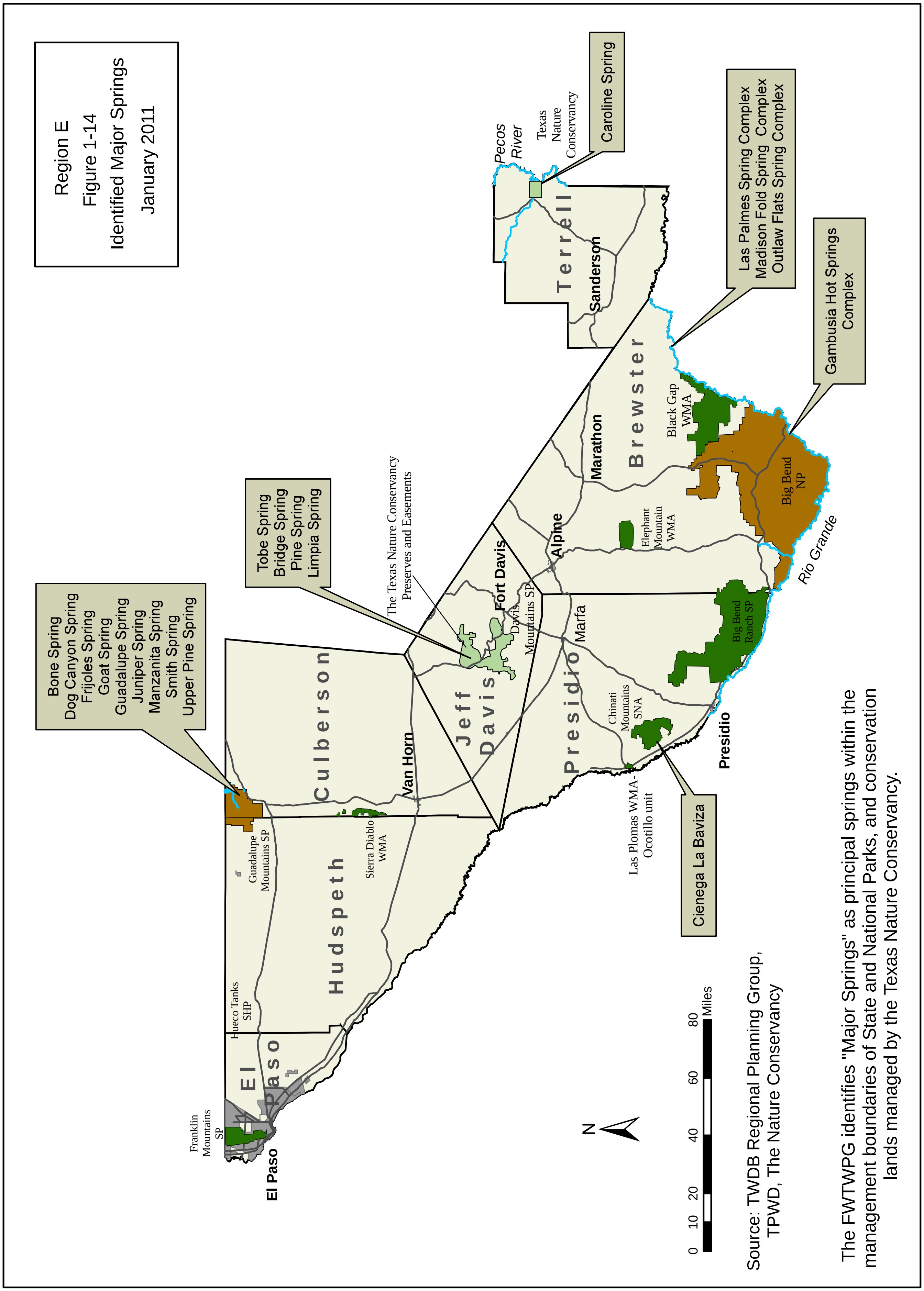

FIGURE 1-14. LOCATION OF IDENTIFIED MAJOR SPRINGS

LBG-GUYTON ASSOCIATES

1.6 WATER MANAGEMENT PLANNING

1.6.1 State Water Plan

The Texas Water Development Board adopted *Water for Texas 2007* in January 2007 as the 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 2007 State Water Plan is the second 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 discusses the Region's:

- Population and water demand
- Existing water supplies
- Water supply needs through 2060
- Recommended water management strategies and cost
- Conservation recommendations
- Ongoing issues and policy recommendations

1.6.2 Water Management and Drought Contingency Plans

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. Drought conditions are defined and described in Section 1.3.5 earlier in this chapter, while Chapter 6, Section 6.2 discusses drought contingency measures in the Region. 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 (EPWU) 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 EPWU and the irrigation districts in El Paso and Hudspeth Counties are provided in Chapter 6 of this Plan.

1.6.3 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.

1.6.4 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 the 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." Five districts are currently in operation within the planning region (Figure 1-15) 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

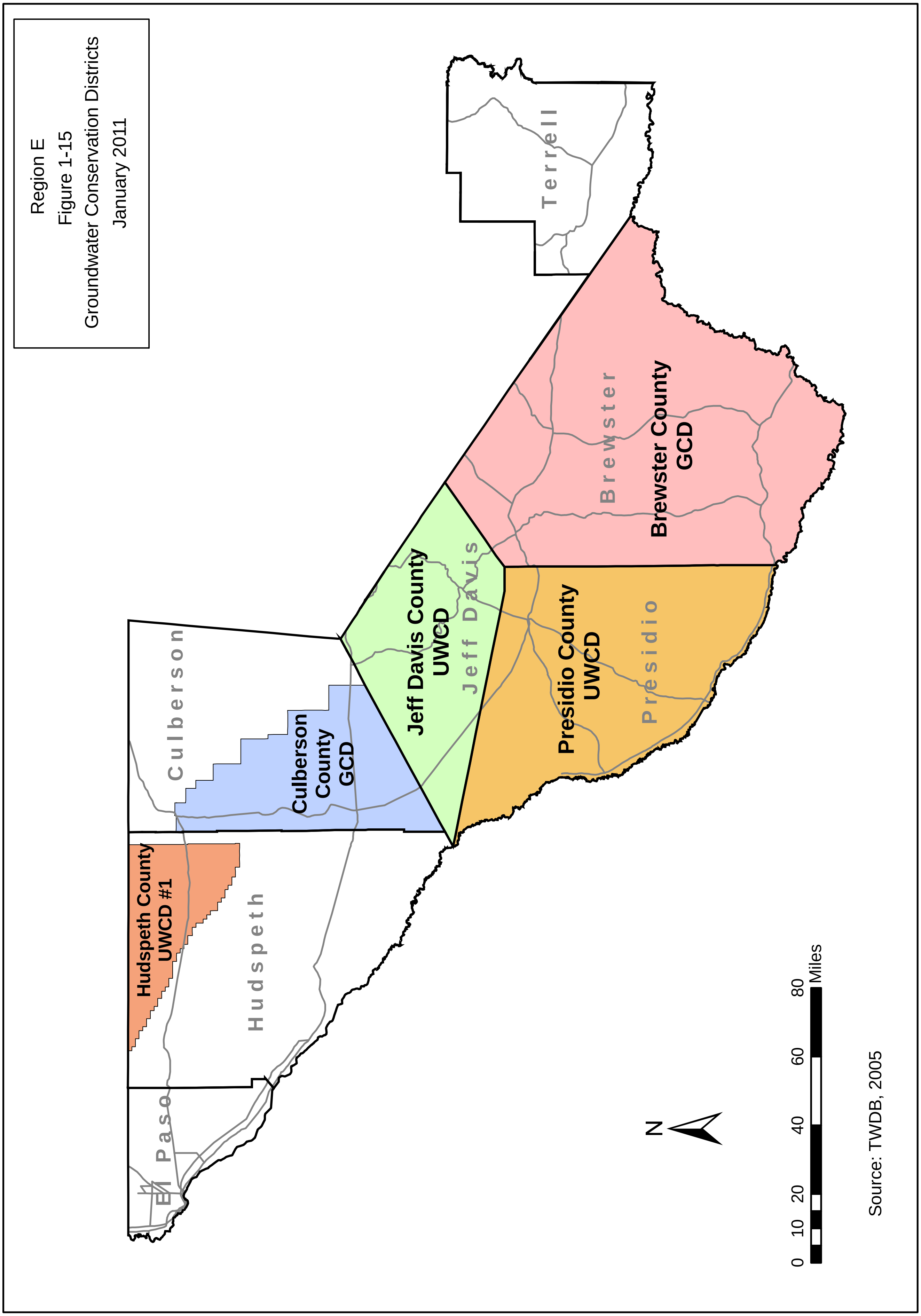

FIGURE 1-15. GROUNDWATER CONSERVATION DISTRICTS

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1.6.5 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.

The TWC and TWDB evaluated groundwater supply conditions in El Paso County in 1990 as part of the "Critical Area" 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.

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 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).

1.6.6 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.

1.6.7 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:

- *Interim 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

1.6.8 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 Far West Texas Water Planning Group, 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.

Conclusions and recommendations from this report are provided in Appendix 1F. The entire report "Far West Texas Climate Change Conference – Study Findings and Conference Proceedings" can be accessed at http://www.twdb.state.tx.us/publications/reports/climatechange.pdf.

1.7 COLONIAS

1.7.1 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.state.tx.us/assistance/financial/fin_infrastructure/edapfund.asp

EDAP projects in Far West Texas are located in El Paso, Hudspeth, and Terrell Counties and are described in the following table. Data pertaining to all

EDAP projects in the State can be accessed through the TWDB web site http://www.twdb.state.tx.us/publications/reports/Colonias/status.pdf.

Table 1-1. Economically Distressed Area Program Projects in Far West Texas (December 31, 2009)

County	Sponsor	Project	Activity	Citizens Served	Cost (Millions)	Status
El Paso	City of El Paso	Canutillo	Water and Wastewater	2,846	$ 11.06	Completed 4/30/02
El Paso	City of El Paso	Westway II	Water and Wastewater	8,187	$ 5.65	Completed 5/23/00
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 and Wastewater	9,299	$ 21.68	Completed 4/11/03
El Paso	Lower Valley Water District	Socorro Phase III/San Elizario	Water and Wastewater	26,403	$ 56.15	Completed 5/19/03
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	1,460	$ 13.69	Under Construction
Hudspeth	Hudspeth County WCID #1	Sierra Blanca	Wastewater	1,100	$ 2.23	Completed 7/28/00
Terrell	Terrell County WCID #1	Sanderson	Wastewater	1,128	$ 4.20	Completed 6/16/03

The TWDB approved a grant in 2010 in the amount of $3,013,000 from the Economically Distressed Areas Program to the Fort Hancock Water Control and Improvement District (District) to finance water system improvements. The District is located in Hudspeth County and provides water service to 249 connections (approximately 1,713 residents) and 231 sewer connections. With these funds, the District plans to construct a new well, a reverse osmosis water treatment plant, discharge evaporation ponds, booster pumps and necessary piping. Most of the planning and design costs have been funded by the US Department of Agriculture-Rural Development (USDA-RD). The construction costs will be jointly funded by the USDA-RD and TWDB.

1.6.2 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 18 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 approximatley 97 percent of the population within El Paso County having access to clean potable water.

Table 1-2 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 constructon 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. El Paso Water Utilities 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 1-2. El Paso County Colonia Projects

(8/19/10)

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	~2500	$ 20,000,000	TWDB	Planning grant application drafted
Lower Valley Water District Horizon MUD	Sand Hills and Other Areas	Water	~1000	TBD	USDA-RD, Others	Under Consideration

1.8 INTERNATIONAL WATER ISSUES

1.8.1 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 below:

Year	Ciudad Juarez Hueco Groundwater Pumping (acre-feet/yr)
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

Pumping over the last two years has increased slightly; however, water conservation efforts in Ciudad Juarez have essentially 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/yr)
- Mesilla (26,000 acre-feet/yr)
- Somero (28,000 acre-feet/yr)
- Profundo (31,000 acre-feet/yr)

In addition, plans are also being developed to convert 38,000 acre-feet/yr 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/yr is used for irrigated agriculture. The conversion would involve supplying wastewater effluent to farmers in exchange for surface water.

1.8.2 El Paso

El Paso is dependent on the Hueco Bolson Aquifer to satisfy approximately 25 percent of its municipal and industrial needs. Since 1989, El Paso has been reducing its pumping from the Hueco. In 2009, EPWU Hueco pumping was 28,172 acre-feet/yr, or approximately half of the amount pumped just 10 years ago. The large reduction in El Paso's dependence on Hueco groundwater can be traced to (1) the City's increasing use of surface water, (2) the adoption of water-conservation programs, (3) the initiation of pricing strategies that discourage excessive water consumption, and (4) an increase in the use of reclaimed water.

1.8.3 Transboundary Effects of Groundwater Pumpage

Prior to 1960, up to 5,000 acre-feet/yr 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/yr over the last decade. Figure 1-16 (Figure 6-20 from Hutchison, 2004) graphically displays this phenomenon.

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.

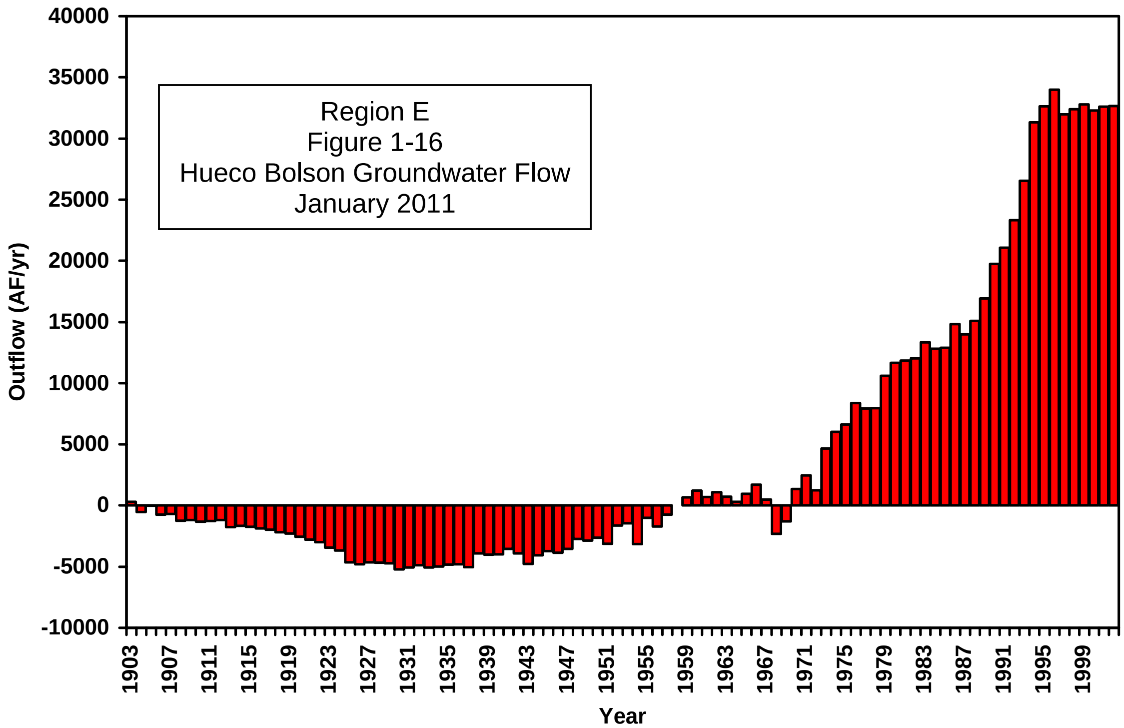

Figure 1-16. Rate of Flow of Hueco Bolson Groundwater from Texas to Mexico

Hutchison (2004) presented the results of simulations of future management alternatives for the Texas portion of the Hueco that included the assumption that Ciudad Juarez pumping would remain at about 122,000 acre-feet/yr. These simulations showed that EPWU pumping of 40,000 acre-feet/yr in years with full allocation of surface water and 75,000 acre-feet/yr in drought years would result in minor storage declines that would not impact existing infrastructure for at least 100 years ("nearly sustainable"). As part of the results of these simulations, groundwater flow from Texas into Mexico would vary between about 34,000 acre-feet/yr and 36,000 acre-feet/yr over the next 50 years.

1.9 STATE AND FEDERAL AGENCIES WITH WATER RESPONSIBILITIES

1.9.1 Texas Water Development Board (TWDB)

The TWDB, 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.

1.9.2 Texas Commission on Environmental Quality (TCEQ)

The TCEQ strives to protect the State's natural resources, consistent with a policy of sustainable economic development. TCEQ's goal is clean air, clean water, and the safe management of waste, with an emphasis on pollution prevention. The TCEQ is the major State agency with regulatory authority over State waters in Texas. 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.

1.9.3 Texas Parks and Wildlife Department (TPWD)

The TPWD 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.

1.9.4 Texas Department of Agriculture (TDA)

The TDA was established by the Texas Legislature in 1907. The TDA has marketing and regulatory responsibilities and administers more than 50 separate laws. The current duties of the department include: (1) promoting agricultural products locally, 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.

1.9.5 Texas State Soil and Water Conservation Board (TSSWCB)

The TSSWCB 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.

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

The IBWC 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.

1.9.7 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 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.

1.9.8 United States Geological Survey (USGS)

The USGS 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.

1.9.9 United States Environmental Protection Agency (EPA)

The mission of the EPA 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.

1.9.10 United States Fish and Wildlife Service (USFWS)

The USFWS enforces federal wildlife laws, manages migratory bird populations, restores nationally significant fisheries, conserves and restores vital wildlife habitat, protects and recovers endangered species, and helps other governments with conservation efforts. It also administers a federal aid program that distributes money for fish and wildlife restoration, hunter education, and related projects across the country.

1.10 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

Appendix 1A

EVALUATION OF IRRIGATION EFFICIENCY STRATEGIES FOR FAR WEST TEXAS: FEASIBILITY, WATER SAVINGS AND COST CONSIDERATIONS

EVALUATION OF IRRIGATION EFFICIENCY STRATEGIES FOR FAR WEST TEXAS: FEASIBILITY, WATER SAVINGS AND COST CONSIDERATIONS

June 2009

Prepared for:
Far West Texas Water Planning Group,
Rio Grande Council of Governments and
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ABSTRACT

Texas recently completed its second round of nationally recognized water planning. The Water Plan for the state addresses how each of 16 regions will supply projected water demands for the next 50 years. Water availability in these plans is based on supply conditions experienced during the drought of record, that is, the severe drought conditions in the 1950's. In arid Far West Texas, Region E in the State Plan, agriculture is projected to have the largest unmet demand for water during drought. This situation is similar to many other irrigated agricultural production regions in the U.S. and world that rely upon limited and variable water supplies. In the Far West Texas (Region E) 50-year Water Plan, the primary strategy proposed to mitigate the impact of insufficient water supplies for agriculture is implementation of water conservation best management practices. However, the conservation practices identified were generic and gave a wide range of potential water savings compiled from many other sources and for other locations and conditions. The feasibility and amount of water saved by any given conservation practice varies substantially across regions, specific location, type and quality of water supplies, delivery systems and operational considerations, crops produced, irrigation technologies in use, and location specific costs and returns of implementation. The applicability to and actual water savings of the proposed practices in Far West Texas were generally unknown.

This report evaluates 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% 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% of the projected unmet agricultural water demand in 2060 during drought-of-record conditions

Overall, there are no silver bullets for agricultural water conservation in Far West Texas short of taking irrigated land out of production when water supplies are limited.

Appendix 1B

Conceptual Evaluation of Surface Water Storage In El Paso County

FINAL REPORT

Conceptual Evaluation of Surface Water Storage in El Paso County

Prepared for
Far West Texas Regional Planning Group

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EPWU Hydrogeology Report 08-02
November 2008

EXECUTIVE SUMMARY

Since the beginning of the 20th century, El Paso Water Utilities (EPWU) has relied on the both surface water and groundwater for municipal water supply. In recent years, these supplies have been managed conjunctively, where surface water use is maximized when available and groundwater pumping is increased in periods when surface water availability is limited. Conjunctive management applies both seasonally and to wet and dry years.

The conjunctive use management of surface water and groundwater resources in El Paso County recognizes that there are limits to surface water supplies and limits to groundwater supplies. The most significant limitation to the surface water supply is that droughts occur, and surface water flows are limited in some years. In these years, groundwater pumping is increased in order to meet demands.

The management of local groundwater requires the recognition of limits with respect to the ability of local groundwater basins to supply water reliably over many decades. Simply increasing local groundwater pumping to meet increased demands has been shown to be an ineffective groundwater management strategy in El Paso in terms of water quantity and water quality. Indeed, the implementation of water management strategies beginning in the early 1990s that included increased diversion from the Rio Grande were primarily designed to reduce Hueco Bolson pumping. More recently, the completion of the Kay Bailey Hutchison Desalination Plant furthers the goals of groundwater management by intercepting brackish groundwater and treating it. This will ensure that fresh groundwater will be available to meet the conjunctive use management objectives of increased groundwater pumping from the Hueco Bolson when drought conditions occur.

The 2006 Regional Water Plan contemplates a slight increase in the use of local surface and groundwater supplies for non-agricultural demands, and the initiation of a groundwater importation project by the year 2030. The objective of this study is to conceptually evaluate three specific surface water storage options: 1) surface storage of Rio Grande water during high flow events for later use in the surface water plants, 2) store treated surface water in the Hueco Bolson, and 3) treat, store and utilize local stormwater runoff. This work was completed as an interim study for the Far West Texas Regional Planning Group. The purpose of this study is to preliminarily assess whether any of these alternatives could be used to further extend EPWU's local supplies. If one or more of them are feasible, more details can be developed as part of the regional planning process.

The conceptual evaluation of potential surface water storage projects in the El Paso area considered three general options: 1) storage of excess Rio Grande Flows, 2) storage of treated Rio Grande water in the Hueco Bolson, and 3) storage of local stormwater.

Cost summaries for 10 conceptual projects were developed. These projects include:

- Two alternative projects at Socorro Ponds
- A project at Ascarate Park that is not evaluated in detail due to the likely view that such a project would interfere with operation of the park
- Two alternative projects at the Upper Valley Water Treatment Plant
- Two alternative projects that would store treated surface water in the Hueco Bolson
- Three alternative projects that would store local stormwater in northeast El Paso

Based on the conceptual descriptions of the projects, their potential operation and the associated costs, it appears that the most feasible is the storage of treated surface water in the Hueco Bolson. If the capital costs for stormwater storage were low (e.g. less than $5 million), storage of stormwater could also be viewed as feasible when compared to other EPWU sources of water.

Clearly, additional detailed analyses of any project would be required prior to making any decisions to develop one or more of these alternatives into a Regional Water Plan strategy or into an actual project. However, the information in this study has identified some opportunities to enhance the use of local water resources that could result in a change in the schedule of groundwater importation currently planned for 2030.

Appendix 1C

Groundwater Data Acquisition in Far West Texas

Groundwater Data Acquisition in Far West Texas

Prepared for:

Far West Texas Water Planning Group

and

Texas Water Development Board

July 2009

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1.0 Executive Summary

Far West Texas contains three Texas Water Development Board (TWDB)-designated major aquifers and six minor aquifers. In addition, there are a number of areas within the Region that have no aquifer designation but in which groundwater is the primary source of supply. The purpose of this project is the establishment of additional aquifer characterization data upon which to base further groundwater availability analyses. The acquisition of additional aquifer characterization data will benefit the Far West Texas Water Planning Group in better defining available water supplies in the region, and will also support groundwater conservation districts in their responsibility of managing supplies and evaluating future desired conditions.

New hydrologic data in the form of static water level and well yields is tabulated from driller's reports on wells that have been drilled in recent years in Brewster, Culberson, Jeff Davis, and Presidio Counties. Where possible, as in Jeff Davis and Presidio Counties, well identification is coordinated between groundwater conservation district tracking numbers and Texas Department of Licensing and Regulation tracking numbers. A limited number of new wells and updated existing well data in eastern Hudspeth County was field measured and observed.

Water samples were collected from 22 wells and springs using recognized standard procedures and the samples were analyzed for basic inorganic constituents. All analyses indicate excellent quality water with total dissolved solids ranging from 87 to 545 milligrams per liter (mg/l). Four aquifer pumping tests were conducted during this project with transmissivities ranging from 190 to 198,570 (gpd/ft) and an additional four pumping tests are included that have been performed in the area but are not noted in the TWDB groundwater files.

Appendix 1D

Water Conservation Conference for Far West Texas Water Plan Region E

Report - Water Conservation Conference for Far West Texas Water Plan Region E

Interlocal Agreement between Rio Grande Council of Governments and El Paso Water Utilities Public Service Board.

Executive Summary

This report summarizes the work done under Study #4: Municipal Water Conservation Education Program found on the interlocal agreement between the Rio Grande Council of Governments (RGCG) and El Paso Water Utilities Public Service Board (EPWU). It includes the purpose of study, background information, methodology, results and recommendations, of the conference held October 17, 2008 at both El Paso TecH20 Center and Ft. Stockton Extension Center.

Purpose of Study

The main goal for the conference was technology and information transfer based on EWPU success. EPWU wanted to share its experiences related to the implementation of conservation programs and incentives. The information presented at the conference was not specifically designed as part of the long range Far West Texas Regional Water Plan of 2011 but as an ongoing intraregional cooperative effort to share information so that regional water purveyors can implement programs that fit their needs in their planning strategies.

Background Information

For more than seventeen years, EPWU has dedicated its efforts and resources to developing and implementing successful water conservation programs. In 1991, our objective was to reduce consumption from an initial 200 gallons per capita per day (gpcd) to 160 gpcd by the end of 2000. As such, consumption dropped to 159 gpcd. Our new goal of reaching 140 gpcd by 2010 was surpassed at the end of 2004 when we reached 139 gpcd. Last year (2008), water consumption reached 133 gpcd. Maintaining a 140 gpcd through 2010 is our new goal. This incredible achievement is attributed to the implementation of best management practices; such as education programs, system audits, rebates and incentives, rate structures, mandatory ordinances and supply side conservation for the complete management of water resources.

Staff from EPWU participated in the Water Conservation Implementation Task Force created by the 78th Texas Legislature under Senate Bill 1094 to review, evaluate and recommend optimum levels of water use efficiency and conservation for the state. As a result, the Water Conservation Best Management Practices Guide was created. The conservation program described in this document incorporates some of the BMP's found on the guide relevant to municipal water users.

In December 2007, EPWU staff requested Far West Texas Water Planning Group Members submit ideas for topics in order to develop relevant conservation training for the water utilities in the Far West Texas Region. The following topics were suggested.

- *Training on the options open to small suppliers for using/selling their WWTP effluent. How do they market it? What are legal use options? How did the purple pipe program get started, funded, and what is involved?*
- *Water conservation programs and best management practices recommended by the Texas Water Development Board and the Water Conservation Implementation Task Force. Including education programs, supply side water conservation, system water audits, landscape water efficiency and xeriscape principles.*

A one day conference was proposed; the conference included two concurrent tracks. The Utility Staff Track was designed for the technical staff of water purveyors. This track incorporated sessions regarding BMP's found on the state guide and on the contract requirements between EPWU and the RGCG.

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. The track included hands-on activities that can be used at school settings and community events. Attending teachers received professional credit hours for their participation in the conference.

Methodology

The conference took place Friday October 17, 2008. Recognizing that the driving distance between the counties in Region E might become a problem; we proposed to offer different venues for this conference.

1. The El Paso site (TecH$_2$0 Center) hosted the one-day conference with two tracks, the Utility Staff Track and the Community Outreach Track.
2. An EPWU facilitator and an Extension Agent were sent to Ft. Stockton site (Extension Center) to host the Community Outreach Track. Both sites were linked via long-distance conferencing and video.
3. In addition, the Utility Staff Track pre-recorded presentations were made available through a link to the El Paso Water Utilities Webpage. This option was offered for those attendees that were interested in such track but couldn't drive to El Paso.

There was no registration cost for the conference. The most important benefits, by offering the conference in the previously described format, were cost savings and work schedule flexibility by minimizing lost work time and expenses due to travel. Additionally, teachers that attended the Community Outreach Track received, at no cost to them, 6 hrs of professional CEU's. Copies of presentations and the conference program are included on attachment "A" at the end of this report.

As per expenses, a description of such along with in-kind donation received, are included on attachment "B" at the end of this report.

An electronic invitation to "save the date" was emailed to a list of members provided by RGCG and TWDB staff. The same printed invitation was mailed to those members with no electronic mail. Such invitations were distributed at the extension service during their fall district meeting. Following the invitation, a conference program was mailed. Registrations were handled via emailed and regular mail. A total of 55 registrations were received; 32 for the Community Outreach Track for both sites, Ft. Stockton (12) and El Paso (20) and 23 for the Utility Track in El Paso. Subsequently, EPWU Webmaster reported 140 web link requests from the link that contained the conference presentations. Such requests were measured during the time the link was available, October 14, 2009 to December 30, 2009. Copies of sing-in sheets included on attachment "C" at the end of this report.

Results

We experienced minor video and audio glitches during the simultaneous broadcasting of the Community Outreach track between El Paso and Ft. Stockton site however; we did received positive comments from attendees.

We only collected evaluation forms from attendees of the Community Track. We did not collect any evaluation forms from the Utility Track attendees. A total of 45 evaluation forms were received from both sites, El Paso and Ft. Stockton, the majority from 3-5 grade teachers. These teachers were mainly rural (10), suburban (2) and urban (7). The majority work at public schools. The following table indicates how attendees rated the Community Outreach track.

How strongly do you agree or disagree with the following statements?	Strongly agree (1)	2	3	4	5	6	Strongly disagree (7)
I acquired new skills at the workshop	14	1	3	4			
The workshop increase my knowledge of how to use water resources as the context for interdisciplinary teaching and learning	13	5	1	3			
Students/participants will learn from Project WET activities	16	3	1	1		1	
The facilitator showed ways to integrate activities into my program	15	3	1	2	1		
The facilitator was well prepared	17	2	1	1	1		
The facilitator demonstrated ways to modify activities	16	2	1	1	1	1	
The facilitator was knowledgeable	17	4	1			1	
It was worth my time to come today	15	4	1	1		1	
I'm excited to use Project WET	16	3		1		1	1

The resources and materials provided at the workshop are useful	16	2	1		1	1	
I will recommend this workshop to colleagues and friends	16	2	3		1		
Overall the workshop was excellent	17	2	1	1		1	

The following are comments from conference attendees:

- I will use some of the ideas to plan future professional development units
- Provided me new ways to use content
- Will incorporate activities
- I will be more interactive
- I became more excited to schedule more programs
- I need a Willie Bingo
- Learned hands-on experiments
- Gave great resources
- Need more information on wastewater treatment, hydrogen fuel cell, methane gas and energy production
- I learned about water conservation
- This workshop meet my expectations
- I learned about water waste through leaks
- I learned about local area issues
- Is there a "friends" organization for the Rio Grande?
- Teleconfercing glitches were only slightly unproductive
- I learned to spend more time in lesson preparation
- I learned a lot! I did not knew
- Tour of the desalination plant would be nice
- Include a vocabulary list
- The information was helpful, relevant for children
- Conference was helpful
- Include more information about pathogens, airborne diseases
- Conference was fun, I'm anxious to use the program in my class
- Add more background information to every presentation
- I usually don't worry about water issues but I'm starting to see all the work it takes to harvest it and to keep it clean
- Give me more ideas to use in my class
- I got a lot more than I planned, thank you very much
- Add more hands-on activities
- Excited to present this in afterschool programs
- Thank you for the conference. This was exactly what we needed and I want to be able to duplicate some of the things ya'll have accomplished. Once again the meeting was very informative.

Recommendations

As stated previously, the conference was designed as a way to transfer information and experiences from a successful conservation program in El Paso, not specifically designed as part of the long range Far West Texas Regional Water Plan of 2011. The information and examples of programs presented at the conference could be used as a model by other water purveyors in the region when designing their own future conservation programs. Based on comments received, the conference was a success.

Appendix 1E

Major Springs

MAJOR SPRINGS

The Far West Texas Water Planning Group recognizes the following "Major Springs" occurring on state, federal, or privately owned conservation-managed lands for their importance for natural resource protection.

<u>Chinati Mountains State Natural Area – Cienega La Baviza Spring</u>

Cienega Creek flows downstream from the spring-fed spring, La Baviza, in the 38,187-acre Chinati Mountains State Natural Area in west-central Presidio County. The spring (cienega) forms a fresh to slightly saline marsh with waters that are slightly geothermal. The habitat supports a fairly intact, diverse marsh with saline grasses, rushes, sedges, and perennials. A high diversity of desert bats also use the area for feeding and watering. The adjacent Cienega Creek has very good examples of saline marsh and cottonwood gallery woodlands. It is an important wildlife area and is located in the low Chihuahuan Desert where intact wetlands and riparian habitat are quite rare. Cienega Creek is recommended as an "Ecologically Unique River or Stream Segment" in Chapter 8.

<u>Big Bend National Park / Rio Grande Wild and Scenic River Spring Complexes</u>

River regulation, agricultural and municipal withdrawals and drought have diminished and altered the discharge patterns for the lower Rio Grande in Far West Texas. The physical and ecological system, once adapted to large and rapid fluctuations in flow, is now adapted to lower and more constant flows. The 250-mile reach of the Rio Grande managed by the National Park Service is the only free flowing reach in the lower Rio Grande. A significant portion of the base flows are provided by groundwater contributions from four spring complexes located in Big Bend National Park and along the Rio Grande Wild and Scenic River. Management Plans for both NPS entities list the protection of springs as critical management concerns. A portion of the Rio Grande Wild and Scenic River is recommended by the planning group as an "Ecologically Unique River and Stream Segment" and is discussed in Chapter 8. NPS staff has identified the following four spring complexes.

Gambusia Hot Springs Complex

River miles	804	814
UTM Coordinates N	3233835	3226468
UTM Coordinates E	702647	694388
Zone 13		

This reach includes hot springs between Mariscal Canyon and Boquillas Canyon. Easily delineated orifices with significant flow include: Gravel Pit, Langford Hot Springs, Lower Hot Springs (a.k.a. VD Springs or Leper Springs), Rio Grande Village Springs 3 and 4, and numerous unnamed springs. Springs on the Mexican side include Ojo Caliente and Boquillas Hot Springs. These springs issue from the upper Cretaceous rock units, the Boquillas and Santa Elena Limestones. Rio Grande Village currently gets its water supply from one of these springs. In addition, this same spring and another nearby spring feed two ponds that contain the world's only population of *Gambusia gaigei*.

Outlaw Flats Spring Complex

River miles	748	762
UTM Coordinates N	3292773	3296392
UTM Coordinates E	725582	716672
Zone 13		

Springs issue from the Glen Rose Limestone. Generally of low volume; however, there is evidence of historical use at a spring on the Texas side (approximately 749.5) near the confluence with Big Canyon. Historical use includes the remains of a spring box.

Las Palmas Spring Complex

River miles	735	742
UTM Coordinates N	3293228	3293608
UTM Coordinates E	737565	732013
Zone 13		

Large volume springs in Del Carmen Limestone. Historical use at Asa Jones waterworks, a withdrawal and distribution system for a candelilla wax camp located on the canyon rim east of Silver Canyon. The system includes pumps, piping, and several rock tanks, one of which is located over a spring emanating from a rock joint. Park Service personnel estimated the spring discharge at 300 gpm. This joint can be followed in both directions beyond the rock walls where additional water discharges. Water enters the river on both sides along a reach approximately 200 feet long. Undocumented Mexican emigrants use this area frequently, as indicated by the presence of discarded clothing and bedrolls. Directly below the Asa Jones Waterworks, on the Texas side is Spigot Spring. River runners use this spring as a water source. Two miles downstream on the Coahuila Mexico, side is Hot Springs, a very popular river camp due to the presence of several warm pools. A road on the Mexican side provides access to the area for the Mexican Army (reports from River District Ranger). Another spring below and on the Texas side is commonly used as a water source for river runners.

Madison Fold Spring Complex

River miles	720	723
UTM Coordinates N	3298065	3296092
UTM Coordinates E	753147	751786
Zone 13		

Low volume springs discharging from the Del Carmen Limestone and the Maxon Sandstone. As these are the last discharges along the river, river runners commonly use the spring on the Texas side and below Lower Madison Falls as a water source.

<u>Guadalupe Mountains National Park Springs Complex</u>

Springs in the Guadalupe Mountains National Park are crucial for maintenance of ecological stability and wildlife health within the Chihuahuan Desert environment. Loss or failure of any of these springs would cause significant environmental stress, even though discharge rates of most are relatively small. Most springs are also historic areas used by pioneers, early ranchers, and settlers. Remains of their homesteads and structures used to manage spring outflow and direct water usage are still visible in and near the springs. The National Park Service is directed to preserve these historic elements and cultural landscapes against unnatural impacts from continued human use, as well as to protect the spring's water quality and quantity from human induced impairment. Specific major natural resource springs are listed in the following table:

SPRINGS IN GUADALUPE MOUNTAINS NATIONAL PARK				
Name	Discharge (gpm)	State Well Number	Position NAD 1927 Conus UTM 13 N northing	Position NAD 1927 Conus UTM 13 N easting
Bone Spring	2-3	-	3527444	512087
Dog Canyon Spring	<1	-	3537770	514918
Frijole Spring	6-13	47-02-801	3530009	518842
Goat Spring	1	-	3529611	511370
Guadalupe Spring	6-10	47-02-701	3526606	514633
Juniper Spring	<1	47-02-502	3531081	519488
Manzanita Spring	10-38	47-02-802	3530317	519111
Smith Spring	13-55	47-02-501	3531248	518287
Upper Pine Spring	8-13	47-02-803	3529514	517274

Texas Nature Conservancy Independence Creek Preserve – Caroline Spring

Caroline Spring is located at the Texas Nature Conservancy's Independence Creek Preserve headquarters in northeastern Terrell County. The spring produces 3,000 to 5,000 gallons per minute and comprises about 25 percent of the creek's flow. Downstream, Independence Creek's contribution increases the Pecos River water volume by 42 percent and reduces the total dissolved solids by 50 percent, thus improving water quantity and quality. The preserve hosts a variety of bird and fish species, some of which are extremely rare. Caroline Spring, along with the entirety of the Independence Creek Preserve (19,740 acres), is a significant piece of West Texas natural heritage.

Texas Nature Conservancy Davis Mountains Preserve – Tobe, Bridge, Pine and Limpia Springs

The wild and remote Davis Mountains is considered one of the most scenic and biologically diverse areas in Texas. Rising above the Chihuahuan desert, the range forms a unique “sky island” surrounded by the lowland desert. Animals and plants living above 5,000 feet are isolated from other similar mountain ranges by vast distances. The Texas Nature Conservancy has established the 32,000-acre Davis Mountains Preserve (with conservation easements on 65,830 acres of adjoining property) in the heart of this region. Tobe, Bridge, Pine and Limpia springs form critical wetland habitat and establish base flow to the downstream creeks.

Appendix 1F

Far West Texas Climate Change Conference

FAR WEST TEXAS CLIMATE CHANGE CONFERENCE

Study Findings and Conference Proceedings

Texas Water Development Board
December 2008

5. 0 Conclusions and Recommendations

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. 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. Conference participants included representatives from the Far West Texas Regional Water Planning Group, water authorities, industrial customers, agricultural interests, municipalities, fishing and recreational interests, environmental advocacy organizations, and institutions of higher education. 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 Regional 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.

Recommendations provided in this section are summarized primarily from the content of conference speaker presentations and from recommendations and observations recorded during the three facilitated conference discussion sessions.

Consistent with the findings of the IPCC reports, conference presenters agreed that surface water resources within the Far West Texas region and the rest of the state are at risk from potential impacts of climate change. These possible impacts could include increases in temperature, which could significantly increase evaporation; increases or decreases in precipitation; and reductions in and earlier melting of snowpack that feeds the Rio Grande headwaters in Colorado.

Conference speakers presented evidence that these types of changes could occur as the result of natural variability as well as from future climate change. And since water planners in the region already understand the nature and consequences of natural climatic variability, local entities such as the U.S. Bureau of Reclamation, El Paso Water Utilities – Public Service Board, Elephant Butte Irrigation District, and El Paso County Water Improvement District No. 1 have planned and designed water infrastructure with such scenarios in mind. Suggestions for dealing with the potential impacts of climate change included the continued use and expansion of water management strategies that are already employed in the region, such as

- upgrading flood management infrastructure to provide adequate flood protection;
- adapting flood control infrastructure to capture more runoff from the monsoon season and accommodate sediment removal, reuse, and environmental enhancement; and
- continuing conjunctive management of surface water and groundwater supplies, direct and indirect reuse of wastewater, and advanced water conservation

Participants and presenters agreed that more research is needed to determine the potential impacts of climate change on Texas. It was suggested the state should evaluate which models are better at analyzing the Texas climate, identify the sources of uncertainty affecting predictions the state's climate, and understand vulnerabilities of water resources to potential evaporation. There was considerable emphasis on the value of tree ring-based reconstructions of streamflow to analyze natural variability in climate systems. Such reconstructions of hydrology can put shorter instrumental records in a long-term context and provide more comprehensive information for water planners to consider.

General policy recommendations from the conference included

- continuing a regional approach to considering climate change in regional water planning;
- establishing a consortium to provide a framework for further research and discussion;
- reconsidering the drought of record as the benchmark scenario for regional water planning; and
- providing more funding for research, data collection, and investments in water infrastructure.

Although climate change could potentially impact the resources of Far West Texas, water managers and planners are in a position to adaptively manage their water resources through the regional water planning process. As local, state, and federal policies change and more resources are secured to improve technologies for research and infrastructure development, the Far West Texas Regional Water Plan can adapt to address these and other uncertainties. Ongoing adaption and an iterative dialogue between water managers, planners, and stakeholders in the region and elsewhere, such as that undertaken at the Far West Texas Climate Change Conference, will bridge the gap between what is uncertain today and what is well within the reach of understanding and realization tomorrow.

CHAPTER 2

POPULATION AND WATER DEMAND

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2.1 INTRODUCTION

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. The Texas Water Development Board (TWDB) regional planning rules specify in Section 357.5 (d) that in developing regional water plans, the Regional Planning Groups shall use for population and water-demand projections one of the following:

- *State population and water demand projections contained in the state water plan or adopted by the board (TWDB) after consultation with the Texas Commission on Environmental Quality, Texas Department of Agriculture (TDA), Texas Parks and Wildlife Department (TPWD), and regional planning groups in preparation for revision of the state water plan; or*
- *Population or water demand projection revisions that have been adopted by the board (TWDB), after coordination with TCEQ, TDA, TPWD, and regional planning groups when the requesting regional planning group demonstrates that the population and water demand projections developed pursuant to paragraph (1) of this subsection no longer represent a reasonable projection of anticipated conditions based on changed conditions and availability of new information.*

Regional population and water demand data was 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' 2000 census count. In accordance with the second criteria above, the FWTWPG requested and was given approval to revise specific population and water-demand data for use in the regional plan. Thus, the population and water demand projections shown in this chapter are derived from a combination of TWDB data and approved revisions.

2.2 POPULATION AND WATER DEMAND PROJECTION REVISIONS

The FWTWPG solicited all entities within the Region to submit desired changes to the draft population and water-demand projections. Revision requests, along with required back-up documentation, were prepared and submitted to the TWDB. Following review by the TWDB, the FWTWPG was granted formal approval to use the revised population and water-demand projection estimates in the regional planning process. The result of the approved population revisions was a net increase of population count reported in the 2006 Far West Texas Water Plan of 7,724 in the year 2010 to 15,111 by the year 2060. Entities affected by the population revision include the Fort Bliss Military Base, El Paso County rural, and Fort Davis.

The greatest increase to population in the Region is associated with the Fort Bliss Military Base. According to information provided by Fort Bliss, there are now 19,300 soldiers stationed at the base, and by 2018, current plans call for having 33,470 soldiers stationed at the base. There are now 20,820 people living on the base, and current plans call for this to increase to 27,630 by 2018. Other soldiers and their dependents will live off the base.

Requested revisions in draft water-demand projections fell into three categories; municipal, irrigation and mining. Revised municipal projections were made for the Fort Bliss Military Base, City of El Paso, El Paso County Other (rural), and Fort Davis. Projected water demand for irrigation use was revised in Culberson, Jeff Davis and Presidio Counties to reflect actual metered water use. And the mining category in Terrell County was revised to reflect increased oil and gas exploration activity.

The military population expansion creates an increased water demand in the City of El Paso geographic area. This current 2011 Plan projects an increase of approximately 4,000 acre-feet of water use by Fort Bliss in the year 2020 over what was projected in the previous 2006 Plan. The new El Paso-Fort Bliss Kay Bailey Hutchison Desalination Facility will generate a new supply of water to assist in meeting this increased need.

2.3 POPULATION

2.3.1 POPULATION PROJECTION METHODOLOGY

Starting with the 2000 census year count, TWDB staff used a cohort-component procedure to calculate population projections. Separate cohorts (age, sex, race, and ethnic groups) and components of cohort change (fertility rates, survival rates, and migration rates) are used to estimate county populations. The projected county population is then allocated to each city containing 500 or more people on the basis of each city's historic share of the county population. 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 2000 base year by decade to the year 2060.

2.3.2 CURRENT AND PROJECTED POPULATION

Although the FWTWPG was legally mandated to use the 2000 census numbers for the purposes of calculating current and projected population figures, 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-2010 projected population for the entire Region is 863,190 of which 97 percent reside in El Paso County and 74 percent in the City of El Paso (Figure 2-1). The regional population is projected to nearly double to 1,542,824 by the year 2060, which is an increase of 679,634 citizens. Most of this increase (671,983) is projected to occur in El Paso County (Figures 2-2 and 2-3).

Table 2-1. Far West Texas Population Projections

COUNTY	WATER USER GROUP*	2010	2020	2030	2040	2050	2060
BREWSTER	Alpine	6,320	6,742	6,929	7,055	7,398	7,474
	County-Other	3,148	3,202	3,226	3,242	3,286	3,296
	BREWSTER TOTAL	**9,468**	**9,944**	**10,155**	**10,297**	**10,684**	**10,770**
CULBERSON	Van Horn	2,743	2,943	3,031	3,060	3,060	3,060
	County-Other	608	653	672	678	678	678
	CULBERSON TOTAL	**3,351**	**3,596**	**3,703**	**3,738**	**3,738**	**3,738**
EL PASO	Anthony	4,586	5,422	6,156	6,789	7,422	8,055
	Clint	980	980	980	980	980	980
	City of El Paso (EPWU)	637,481	717,651	788,014	848,699	909,384	970,069
	El Paso County WCID #4	12,507	17,234	21,383	24,961	28,539	32,117
	Fort Bliss	21,000	27,630	27,630	27,630	27,630	27,630
	Horizon Regional MUD	23,177	36,018	47,288	57,007	66,726	76,445
	Lower Valley Water District	12,505	19,752	26,113	31,599	37,085	42,571
	San Elizario	20,444	31,112	40,475	48,551	56,627	64,703
	Socorro	33,017	39,675	45,519	50,559	55,599	60,639
	El Paso County Tornillo WID	5,542	8,692	11,457	13,842	16,227	18,612
	Vinton	3,708	5,769	7,578	9,138	10,698	12,258
	County-Other	58,693	90,716	118,821	143,062	167,303	191,544
	EL PASO TOTAL	**833,640**	**1,000,651**	**1,141,414**	**1,262,817**	**1,384,220**	**1,505,623**
HUDSPETH	Sierra Blanca	608	661	688	688	688	688
	County-Other	3,207	3,485	3,626	3,626	3,626	3,626
	HUDSPETH TOTAL	**3,815**	**4,146**	**4,314**	**4,314**	**4,314**	**4,314**
JEFF DAVIS	Fort Davis	1,700	2,000	2,200	2,400	2,600	2,800
	County-Other	1,235	1,249	1,249	1,249	1,249	1,249
	JEFF DAVIS TOTAL	**2,935**	**3,249**	**3,449**	**3,649**	**3,849**	**4,049**
PRESIDIO	Marfa	2,585	2,855	3,154	3,154	3,154	3,154
	Presidio	5,360	6,589	7,746	8,777	9,286	9,577
	County-Other	880	740	608	490	432	399
	PRESIDIO TOTAL	**8,825**	**10,184**	**11,508**	**12,421**	**12,872**	**13,130**
TERRELL	Sanderson	921	956	956	956	956	956
	County-Other	235	244	244	244	244	244
	TERRELL TOTAL	**1,156**	**1,200**	**1,200**	**1,200**	**1,200**	**1,200**
	REGION TOTAL	**863,190**	**1,032,970**	**1,175,743**	**1,298,436**	**1,420,877**	**1,542,824**

*Water User Groups are incorporated cities with a year-2000 population of 500 or more, and utilities that provided more than 280 acre-feet of water to its service area.

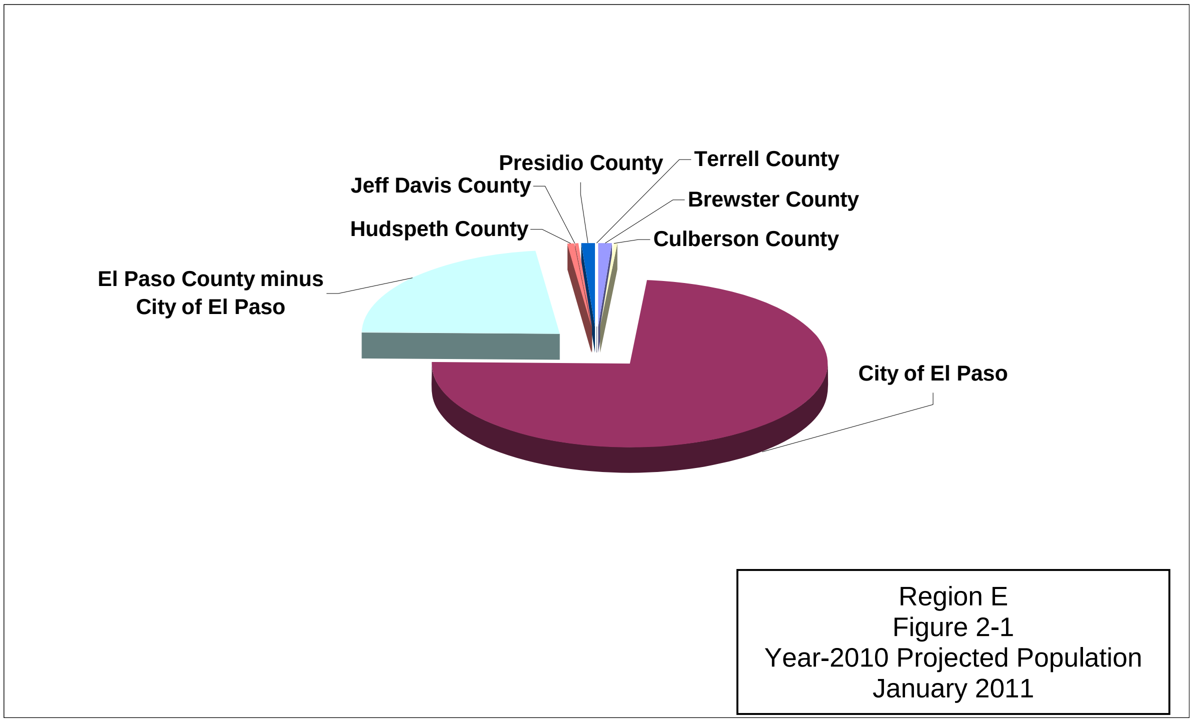

Figure 2-1. Year-2010 Projected Population by County

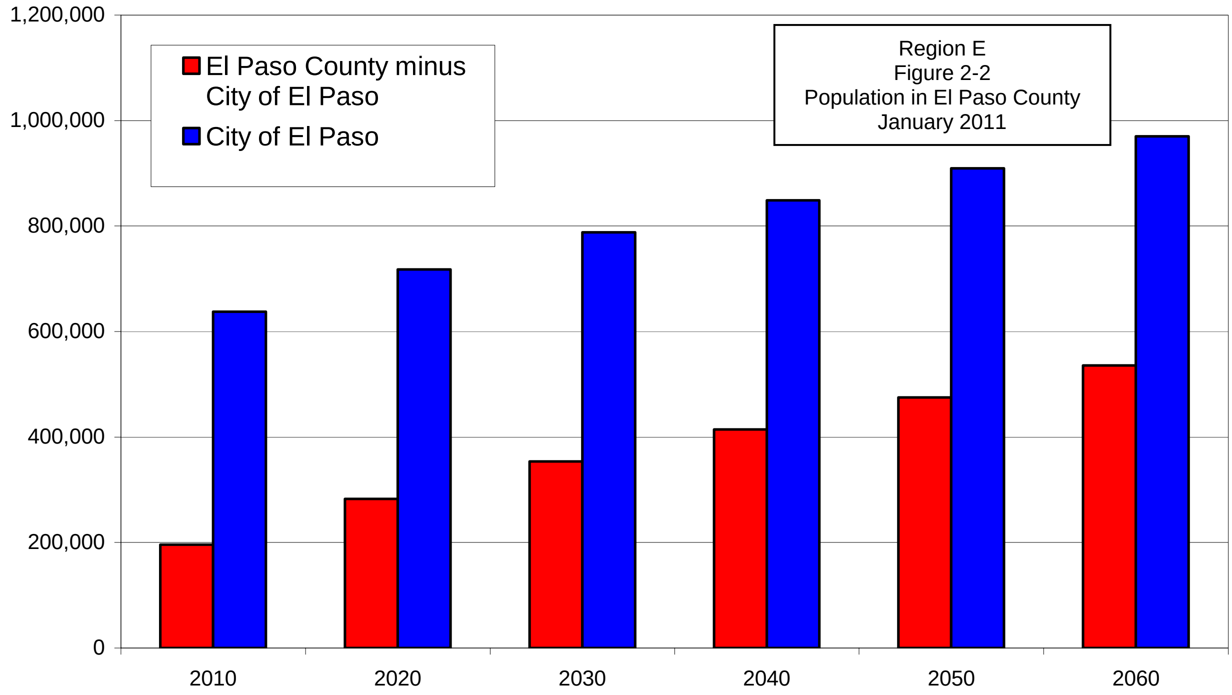

Figure 2-2. Population Projection Distribution in El Paso County

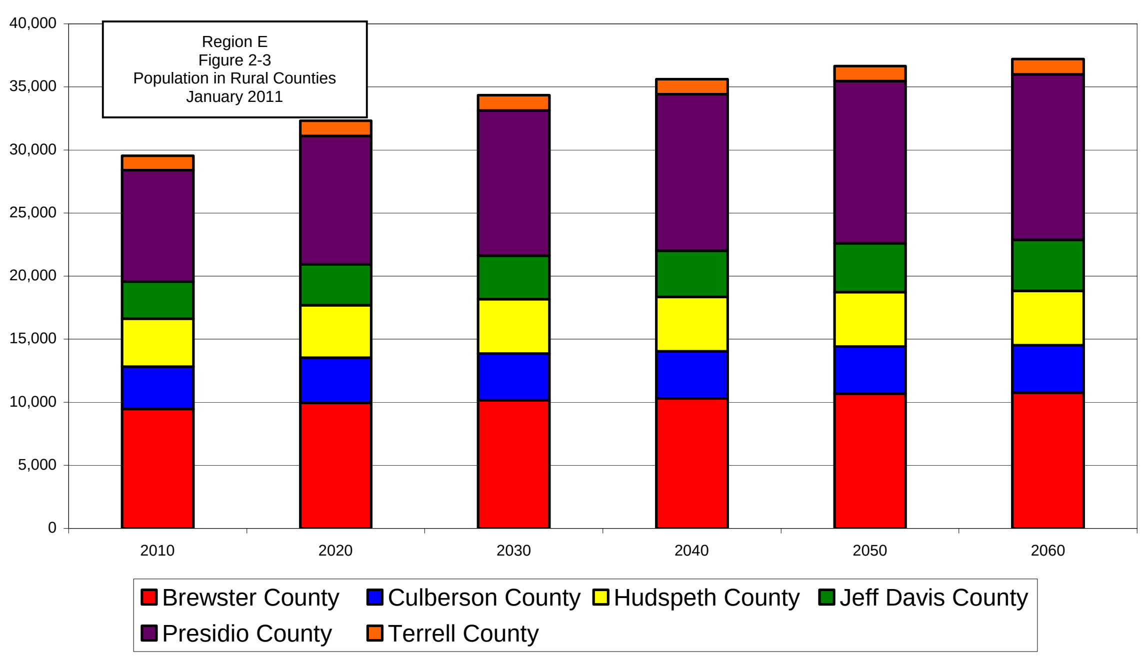

Figure 2-3. Population Projection Distribution in Rural Counties

2.4 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-2010 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 2.5) 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. From the year 2010 to 2060 the total water demand in the Region is projected to increase from 648,126 to 699,586 acre-feet.

The potential role of conservation is an important factor in projecting future water supply requirements. Water demands listed in the *2006 Far West Texas Water Plan* included demand adjustments based on expected conservation practices. In this 2011 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 4 and as a component of drought management plans in Chapter 6.

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. This information has been taken from the 2007 State Water Plan *(Water For Texas – 2007)* and *Exhibit B – Guidelines for Regional Water Plan Development*. The 2007 State Water Plan can be found on the TWDB web page (http://www.twdb.state.tx.us).

Table 2-2. FAR WEST TEXAS WATER DEMAND PROJECTIONS

(Acre-Feet/Year)

COUNTY	WATER USER GROUP	2010	2020	2030	2040	2050	2060
BREWSTER	Alpine	1,791	1,888	1,917	1,928	2,014	2,034
	County-Other	451	448	441	432	431	432
	Manufacturing	4	4	4	4	4	4
	Irrigation	1,622	1,613	1,605	1,596	1,588	1,580
	Mining	576	554	546	539	532	523
	Livestock	707	707	707	707	707	707
	BREWSTER TOTAL	**5,151**	**5,214**	**5,220**	**5,206**	**5,276**	**5,280**
CULBERSON	Van Horn	839	890	907	905	901	901
	County-Other	74	78	78	77	76	76
	Manufacturing	0	0	0	0	0	0
	Irrigation	46,759	45,758	44,779	43,821	42,883	41,965
	Mining	1,514	1,560	1,577	1,594	1,610	1,632
	Livestock	344	344	344	344	344	344
	CULBERSON TOTAL	**49,530**	**48,630**	**47,685**	**46,741**	**45,814**	**44,918**
EL PASO	Anthony	719	826	924	1,004	1,089	1,182
	Clint	270	268	268	267	267	267
	City of El Paso (EPWU)	92,829	104,503	114,750	123,586	132,423	141,260
	El Paso County WCID #4	1,583	2,124	2,587	2,992	3,389	3,813
	Fort Bliss	10,953	12,359	12,359	12,359	12,359	12,359
	Horizon Regional MUD	3,593	5,527	7,224	8,684	10,165	11,646
	Lower Valley Water District	1,121	1,726	2,282	2,725	3,199	3,672
	San Elizario	1,924	2,858	3,718	4,405	5,138	5,871
	Socorro	2,959	3,466	3,977	4,361	4,795	5,230
	El Paso County Tornillo WID	534	818	1,078	1,287	1,509	1,730
	Vinton	399	614	798	962	1,126	1,291
	County-Other	6,278	9,392	11,903	13,867	15,862	18,154
	Manufacturing	9,181	9,994	10,692	11,367	11,941	12,855
	Mining	157	153	151	149	147	146
	Steam Electric Power	3,131	6,937	8,111	9,541	11,284	13,410
	Irrigation	247,111	242,798	240,848	232,380	228,579	224,840
	Livestock	1,742	1,742	1,742	1,742	1,742	1,742
	EL PASO TOTAL	**384,484**	**406,105**	**423,412**	**431,678**	**445,014**	**459,468**
HUDSPETH	Sierra Blanca	123	130	134	132	131	131
	County-Other	287	297	301	288	284	284
	Manufacturing	2	2	2	2	2	2
	Irrigation	182,627	178,840	175,132	171,501	167,945	164,463
	Mining	1	1	1	1	1	1
	Livestock	613	613	613	613	613	613
	HUDSPETH TOTAL	**183,653**	**179,883**	**176,183**	**172,537**	**168,976**	**165,494**
JEFF DAVIS	Fort Davis	343	403	444	484	524	565
	County-Other	162	159	155	151	150	150
	Manufacturing	0	0	0	0	0	0
	Irrigation	591	587	584	581	578	574
	Mining	0	0	0	0	0	0
	Livestock	508	508	508	508	508	508
	JEFF DAVIS TOTAL	**1,604**	**1,657**	**1,691**	**1,724**	**1,760**	**1,797**

PRESIDIO	Marfa	886	969	1,060	1,049	1,042	1,042
	Presidio	1,039	1,255	1,458	1,642	1,727	1,781
	County-Other	81	66	52	42	37	34
	Manufacturing	0	0	0	0	0	0
	Irrigation	20,304	19,906	19,515	19,132	18,757	18,390
	Mining	7	7	7	7	7	7
	Livestock	622	622	622	622	622	622
	PRESIDIO TOTAL	**22,939**	**22,825**	**22,714**	**22,494**	**22,192**	**21,876**
TERRELL	Sanderson	200	205	201	198	197	197
	County-Other	38	39	38	37	37	37
	Manufacturing	0	0	0	0	0	0
	Irrigation	78	77	75	73	72	70
	Mining	142	142	142	142	142	142
	Livestock	307	307	307	307	307	307
	TERRELL TOTAL	**765**	**770**	**763**	**757**	**755**	**753**
	REGION TOTAL	**648,126**	**665,084**	**677,668**	**681,137**	**689,787**	**699,586**

While Table 2-2 lists TWDB approved water demand projections, Table 2-3 provides what the FWTWPG considers to be a more realistic outlook of future irrigation and livestock use in Jeff Davis and Presidio Counties. Although not presently in operation, existing irrigation wells in Jeff Davis and Presidio Counties could be placed back in use. Likewise, livestock numbers in Jeff Davis County suppressed by a number of years of drought conditions, will likely increase as weather and rangeland conditions improve.

Table 2-3. Regional Planning Group Perspective on Projected Irrigation and Livestock Demands in Jeff Davis and Presidio Counties

(Acre-Feet/Year)

COUNTY	WATER USER GROUP	2010	2020	2030	2040	2050	2060
JEFF DAVIS	Irrigation	3,119	3,057	2,995	2,935	2,875	2,816
	Livestock	547	547	547	547	547	547
PRESIDIO	Irrigation	25,156	24,646	24,145	23,655	23,175	22,705

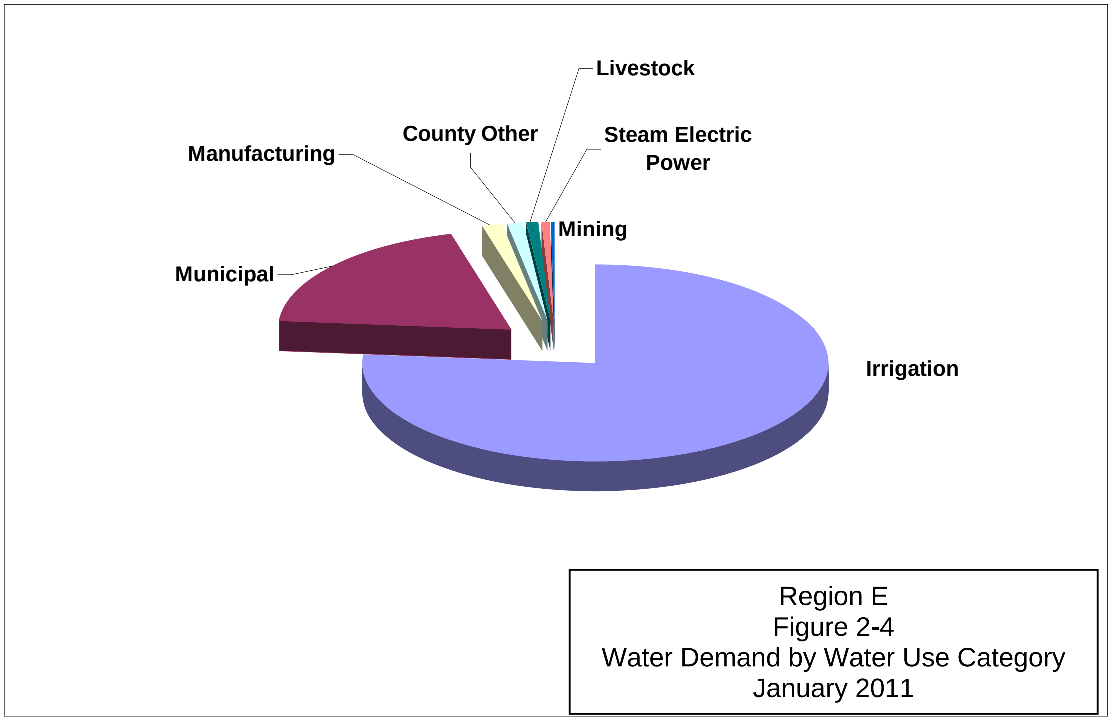

Figure 2-4. Projected Year-2010 Regional Water Demand by Water Use Category

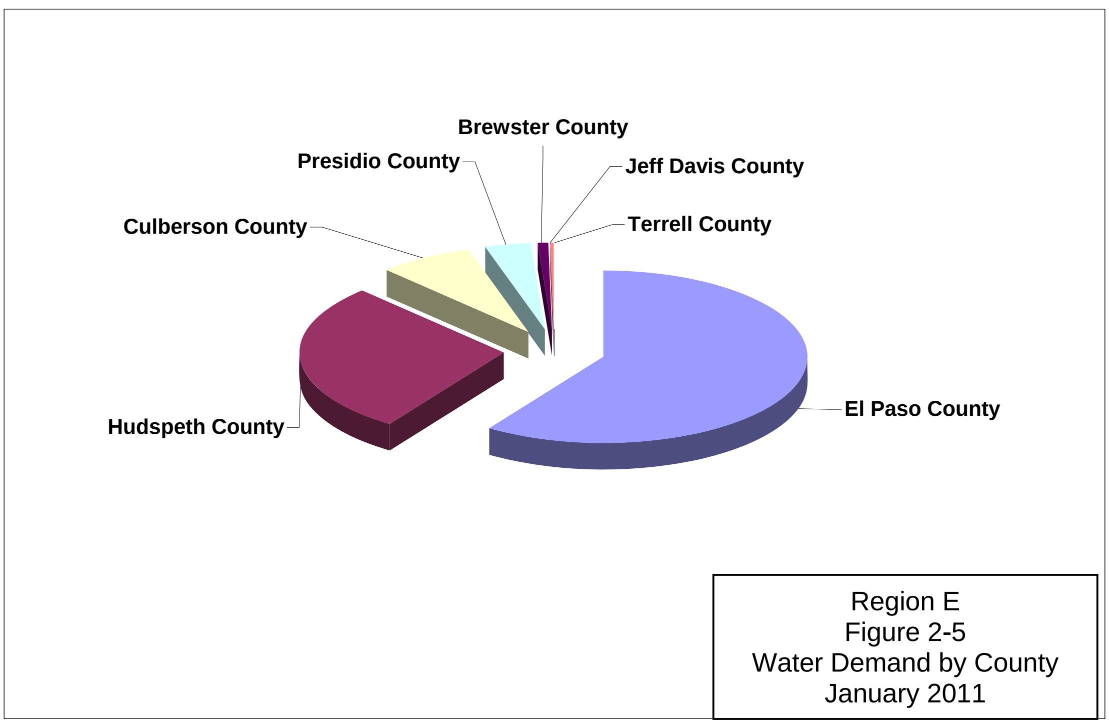

Figure 2-5. Projected Year-2010 Regional Water Demand by County

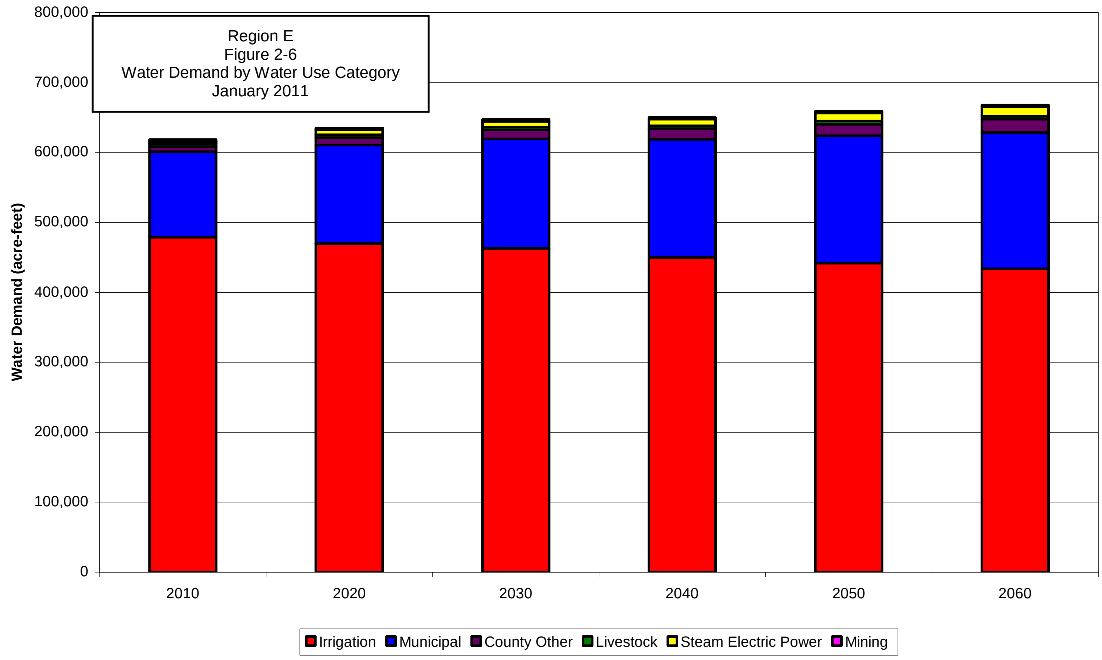

Figure 2-6. Projected Regional Water Demand by Water Use Category

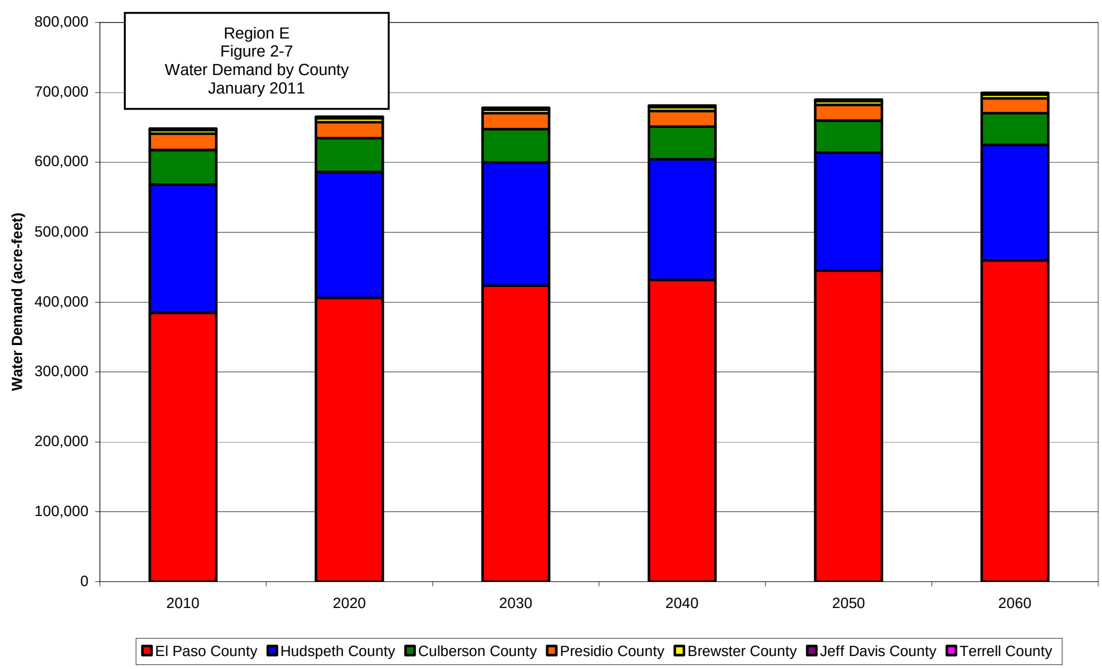

Figure 2-7. Projected Regional Water Demand by County

2.4.1 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 regional water plan (2006), 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 (2006–2011). Table 2-4 lists projected water demands for wholesale water providers in Far West Texas and their customers.

Table 2-4. Wholesale Water Provider Water Demand
(Acre-feet per year)

Wholesale Water Provider / Receiving Entities	2,010	2,020	2,030	2,040	2,050	2,060
El Paso County WID #1						
El Paso Water Utilities	49,100	49,100	49,100	49,100	49,100	49,100
El Paso Water Utilities						
City of El Paso	98,829	104,503	114,750	123,586	132,423	141,260
Fort Bliss	3,376	8,992	9,998	8,998	9,004	9,004
Lower Valley Water District	6,274	8,318	10,245	11,758	13,399	15,040
Vinton	399	614	798	962	1,126	1,291
Manufacturing	9,181	9,994	10,692	11,367	11,941	12,855
Mining	157	153	151	149	147	146
Steam Electric Power	3,131	6,937	8,111	9,541	11,284	13,410
County Other	3,139	6,253	8,764	10,728	12,723	15,015
Lower Valley Water District						
San Elizario	1,924	2,858	3,718	4,405	5,138	5,871
Socorro	2,959	3,466	3,977	4,361	4,795	5,230
Clint	270	268	268	267	267	267
Other Retail Customers	1,121	1,726	2,282	2,725	3,199	3,672

2.4.2 MUNICIPAL

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 water demand is calculated for the communities and utilities designated in the population projections process and includes rural domestic use. Projected municipal water demand is based on the year-2000 per-capita water use, which is calculated with year-2000 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-2000 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.

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.

Municipal and County Other Water Use Projection (in acre-feet/yr)

	2010	2020	2030	2040	2050	2060
Brewster	2,242	2,336	2,358	2,360	2,445	2,466
Culberson	913	968	985	982	977	977
El Paso	123,162	144,481	161,868	176,499	191,321	206,475
Hudspeth	410	427	435	420	415	415
Jeff Davis	505	562	599	635	674	715
Presidio	2,006	2,290	2,570	2,733	2,806	2,857
Terrell	238	244	239	235	234	234

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 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)

2.4.3 MANUFACTURING

Manufacturing and industrial water use is quantified separately from municipal use even though the demand centers may be located within a city limits. Future manufacturing and industrial water use is largely dependent on technological changes in the production process, on improvements in water-efficient technology, and on the economic climate of the marketplace. Technological changes in production affect how water is used in the production process, while improvements in water-efficient technology affect how much water is used in the production process. As older production facilities and accompanying production processes are modernized or retooled, the new production processes are anticipated to be more resource efficient.

The use of water for manufacturing purposes only occurs in Brewster, El Paso and Hudspeth Counties. Use in Brewster and Hudspeth Counties is minimal and is not anticipated to change significantly over time. Manufacturing water use in El Paso County, however, is expected to increase from 9,181 acre-feet in the year 2010 to 12,855 acre-feet by 2060. While a portion of this water is self-supplied, most will be purchased from various water supply entities, principally El Paso Water Utilities.

Manufacturing Water Use Projection (in acre-feet/yr)

	2010	2020	2030	2040	2050	2060
Brewster	4	4	4	4	4	4
Culberson	0	0	0	0	0	0
El Paso	9,181	9,994	10,692	11,367	11,941	12,855
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

2.4.4 IRRIGATION

A comprehensive irrigation survey was performed for the TWDB in 2000 that provided up-to-date crop and irrigation data. The acreage planted for each crop under irrigation, along with the water application rate for each crop, was estimated by the Natural Resource Conservation Service (NRCS) and computed to give total irrigation use for each county. Included in this projection is water applied to private (non-municipally owned) golf courses, greenhouse operations, and container-plant farms. Irrigation water demand includes estimates of surface water lost in the process of transportation to the field. In lieu of the above process, irrigation districts could provide more accurate estimates based on actual measured diversions or pumping withdrawals. Future irrigation use is then projected from this 2000 base year at a rate established for the same county irrigation projection in the previous regional water plan.

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

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.

Irrigation Water Use Projection (in acre-feet/yr)

	2010	2020	2030	2040	2050	2060
Brewster	1,622	1,613	1,605	1,596	1,588	1,580
Culberson	46,759	45,758	44,779	43,821	42,883	41,965
El Paso	247,111	242,798	240,848	232,380	228,579	224,840
Hudspeth	182,627	178,840	175,132	171,501	167,945	164,463
Jeff Davis*	3,119	3,057	2,995	2,935	2,875	2,816
Presidio**	25,156	24,646	24,145	23,655	23,175	22,705
Terrell	78	77	75	73	72	70

* As reported by the Jeff Davis County Underground Water Conservation District

** As reported by the Presidio County Underground Water Conservation District

2.4.5 STEAM-ELECTRIC POWER GENERATION

In determining current and future water use for steam-electric power generation, the TWDB relies on several types of information. Current water use is obtained for each plant from the TWDB's water use survey. Future water demand is estimated using a combination of available information, including published documents on planned additions to existing plants, existing water rights permits, specific company information, lignite-resource ownership, and other related sources. Individual plant design, thermodynamic operating characteristics, energy-conservation strategies, and technological improvements are also evaluated to determine how water use will change over time.

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. 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.

Steam Electric Power Generation Water Use Projection (in acre-feet/yr)

	2010	2020	2030	2040	2050	2060
Brewster	0	0	0	0	0	0
Culberson	0	0	0	0	0	0
El Paso	3,131	6,937	8,111	9,541	11,284	13,410
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

2.4.6 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.

Estimating livestock water consumption is a straightforward procedure that consists of estimating water consumption for a livestock unit and the total number of livestock. Texas A&M University Cooperative Extension Service provides information on water-use rates, estimated in gallons per day per head, for each type of livestock: cattle, poultry, sheep and lambs, hogs and pigs, horses, and goats. The Texas Agricultural Statistics Service provides current and historical numbers of livestock by livestock type and county. Water-use rates are then multiplied by the number of livestock for each livestock type for each county.

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.

Livestock Water Use Projection (in acre-feet/yr)

	2010	2020	2030	2040	2050	2060
Brewster	707	707	707	707	707	707
Culberson	344	344	344	344	344	344
El Paso	1,742	1,742	1,742	1,742	1,742	1,742
Hudspeth	613	613	613	613	613	613
Jeff Davis*	547	547	547	547	547	547
Presidio	622	622	622	622	622	622
Terrell	307	307	307	307	307	307

* As reported by the Jeff Davis County Underground Water Conservation District

2.4.7 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. For each category of mineral products, the requirements for mining water were determined as a function of production. TWDB's estimates of future production were calculated by analyzing both recent data, and state and national production trends. A water-use coefficient, computed from data collected by the TWDB's Water Use Survey, which reports the quantity of water used in the production of each increment of output, was applied to estimated mineral production levels. A rate of water consumption derived from U.S. Bureau of Mines data was then applied to the total water use for each mineral industry.

Much of the water used in the mining industry in Far West Texas 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. As a result, increased water demand is projected for the mining category in Terrell County

Mining Water Use Projection (in acre-feet/yr)

	2010	2020	2030	2040	2050	2060
Brewster	576	554	546	539	532	523
Culberson	1,514	1,560	1,577	1,594	1,610	1,632
El Paso	157	153	151	149	147	146
Hudspeth	1	1	1	1	1	1
Jeff Davis	0	0	0	0	0	0
Presidio	7	7	7	7	7	7
Terrell	142	142	142	142	142	142

2.5 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 4. 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 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 4, 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.

CHAPTER 3

REGIONAL WATER SUPPLY SOURCES

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3.1 INTRODUCTION

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. The entire Far West Texas planning region is located within the Rio Grande Basin. 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. 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. 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. 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 to meet existing permits is determined by using the TCEQ Rio Grande Water Availability Model (WAM) – Run 3.
- The availability of groundwater is based on acceptable levels of water level decline as simulated with Groundwater Availability Models (GAMs) or historical maximum pumpage estimates. 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 anticipated build-out of their "purple pipe" project.
- No availability requirements or limitations 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 Section 1.6.3).
- 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, 3-2 and 3-3 and are reported in "acre-feet/year" (one acre-foot equals 325,851 gallons). Table 3-1 indicates the maximum amount of water supply that could be obtained from each unique supply source.

Table 3-2 lists water supplies that are available to cities and water-user categories, 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. Estimates for county categories of irrigation, mining and livestock are based on the largest annual amount estimated to have been used from 1990 to 2000. This period of time encompasses both dry years and current infrastructure (wells, pipelines, canals, etc.). Culberson County irrigation supply is based on the 2008 groundwater use metered by the Culberson County Groundwater Conservation District.

Table 3-3 lists water supplies available to each of the Wholesale Water Providers designated in Chapters 1 and 2. These supplies represent the total amount of water available to all the entities that each Wholesale Water Provider serves as shown in Table 3-2. Again, the available water supplies listed in all three tables are based on drought-of record conditions.

Table 3-1. Water Supply Source Availability
(Acre-Feet/Year)

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.

Water Supply Source	County	2010	2020	2030	2040	2050	2060
Upper Rio Grande	El Paso	66,631	66,631	66,631	66,631	66,631	66,631
	Hudspeth	632	632	632	632	632	632
Upper Rio Grande Return Flows	El Paso	42,134	47,239	47,239	47,239	47,239	47,239
Upper Rio Grande Return Flows	Hudspeth	334	334	334	334	334	334
Lower Rio Grande	Brewster	8,082	8,082	8,082	8,082	8,082	8,082
	Hudspeth	518	518	518	518	518	518
	Presidio	10,853	10,853	10,853	10,853	10,853	10,853
	Terrell	152	152	152	152	152	152
Pecos River	Terrell	524	524	524	524	524	524
Direct Reuse	El Paso	7,387	10,531	13,676	16,820	19,964	23,109
Hueco Bolson	El Paso	110,000	110,000	110,000	110,000	110,000	110,000
	Hudspeth	16,000	16,000	16,000	16,000	16,000	16,000
Mesilla Bolson	El Paso	52,000	52,000	52,000	52,000	52,000	52,000
Edwards-Trinity (Plateau)	Brewster	300	300	300	300	300	300
	Culberson	55	55	55	55	55	55
	Jeff Davis	200	200	200	200	200	200
	Terrell	2,200	2,200	2,200	2,200	2,200	2,200
Bone Spring - Victorio Peak	Hudspeth	63,000	63,000	63,000	63,000	63,000	63,000

Capitan Reef (Diablo Farms)	Brewster	50	50	50	50	50	50
	Culberson	20,000	20,000	20,000	20,000	20,000	20,000
	Hudspeth	5,100	5,100	5,100	5,100	5,100	5,100
Igneous	Brewster	5,000	5,000	5,000	5,000	5,000	5,000
	Culberson	100	100	100	100	100	100
	Jeff Davis	2,000	2,000	2,000	2,000	2,000	2,000
	Presidio	7,000	7,000	7,000	7,000	7,000	7,000
Marathon	Brewster	200	200	200	200	200	200
Rustler	Culberson	1,000	1,000	1,000	1,000	1,000	1,000
West Texas Bolson Red Light Draw	Hudspeth	1,631	1,631	1,631	1,631	1,631	1,631
West Texas Bolson (Eagle Flat)	Hudspeth	2,869	2,869	2,869	2,869	2,869	2,869
West Texas Bolson (Green River Valley)	Hudspeth	82	82	82	82	82	82
	Jeff Davis	82	82	82	82	82	82
	Presidio	82	82	82	82	82	82
West Texas Bolson (Presidio-Redford)	Presidio	8,000	8,000	8,000	8,000	8,000	8,000
West Texas Bolson (Salt Basin)	Culberson	38,000	38,000	38,000	38,000	38,000	38,000
	Jeff Davis	8,000	8,000	8,000	8,000	8,000	8,000
	Presidio	12,000	12,000	12,000	12,000	12,000	12,000
Other Aquifers (Cretaceous Limestones)	Brewster	2,200	2,200	2,200	2,200	2,200	2,200
Other Aquifers (Balmorhea Alluvium)	Jeff Davis	274	274	274	274	274	274
Other Aquifers (Rio Grande Alluvium)	El Paso	89,000	89,000	89,000	89,000	89,000	89,000
Other Aquifers (Rio Grande Alluvium)	Hudspeth	15,000	15,000	15,000	15,000	15,000	15,000

TABLE 3-2. WATER USER GROUP WATER SUPPLY CAPACITY (Acre-Feet/Year)

Water supply capacity based on current infrastructure, existing contracts, and source supply availability under drought-of-record conditions.

County	Water User Group	Supply Source Name	Infrastructure Capacity per Source	Total Infrastructure Capacity					
				2010	2020	2030	2040	2050	2060
BREWSTER	ALPINE	Igneous (Brewster County)	3,843	4,864	4,864	4,864	4,864	4,864	4,864
		Igneous (Jeff Davis County)	1,021						
	COUNTY OTHER	Edwards-Trinity (Plateau)	23	455	455	455	455	455	455
		Igneous	273						
		Marathon	68						
		Other Aquifer (Cretaceous Limestones)	91						
	MANUFACTURING	Igneous	4	4	4	4	4	4	4
	MINING	Igneous	348	696	696	696	696	696	696
		Other Aquifer (Cretaceous Limestones)	348						
	IRRIGATION	Other Aquifer (Cretaceous Limestones)	1,330	8,790	8,790	8,790	8,790	8,790	8,790
		Lower Rio Grande	7,460						
	LIVESTOCK	Edwards-Trinity (Plateau)	239	798	798	798	798	798	798
		Igneous	240						
		Marathon	80						
		Other Aquifer (Cretaceous Limestones)	239						
CULBERSON	VAN HORN	West Texas Bolson (Salt Basin)	2,084	2,084	2,084	2,084	2,084	2,084	2,084
	COUNTY OTHER	West Texas Bolson (Salt Basin)	62	78	78	78	78	78	78
		Edwards-Trinity (Plateau)	8						
		Rustler	8						
	MINING	West Texas Bolson (Salt Basin)	1,312	2,161	2,161	2,161	2,161	2,161	2,161
		Rustler	849						
	IRRIGATION	West Texas Bolson (Salt Basin)	33,886	46,759	46,759	46,759	46,759	46,759	46,759
		Capitan Reef	12,873						
	LIVESTOCK	West Texas Bolson (Salt Basin)	299	466	466	466	466	466	466
		Edwards-Trinity (Plateau)	47						
		Rustler	120						

TABLE 3-2. WATER USER GROUP WATER SUPPLY CAPACITY (Acre-Feet/Year)

Water supply capacity based on current infrastructure, existing contracts, and source supply availability under drought-of-record conditions.

County	Water User Group	Supply Source Name	Infrastructure Capacity per Source	Total Infrastructure Capacity					
				2010	2020	2030	2040	2050	2060
EL PASO	ANTHONY	Hueco - Mesilla Bolson	3,065	3,065	3,065	3,065	3,065	3,065	3,065
	CLINT	Hueco - Mesilla Bolson	276	276	276	276	276	276	276
		Rio Grande	0						
	CITY OF EL PASO (EPWU)	Rio Grande	45,667	127,567	127,567	127,567	127,567	127,567	127,567
		Direct Reuse	6,000						
		Hueco - Mesilla Bolson	75,900						
	EL PASO COUNTY WCID #4	Hueco - Mesilla Bolson	4,445	4,445	4,445	4,445	4,445	4,445	4,445
	FORT BLISS	Hueco - Mesilla Bolson	21,476	21,694	21,694	21,694	21,694	21,694	21,694
		Rio Grande	218						
	HORIZON REGIONAL MUD	Hueco - Mesilla Bolson	560	3,920	3,920	3,920	3,920	3,920	3,920
		Other aquifer (Rio Grande Alluvium)	3,360						
	LOWER VALLEY WATER DISTRICT	Hueco - Mesilla Bolson	876	1,121	1,121	1,121	1,121	1,121	1,121
		Rio Grande	245						
	SAN ELIZARIO	Hueco - Mesilla Bolson	1,373	1,924	1,924	1,924	1,924	1,924	1,924
		Rio Grande	551						
	SOCORRO	Hueco - Mesilla Bolson	1,666	2,959	2,959	2,959	2,959	2,959	2,959
		Rio Grande	1,293						
	EL PASO COUNTY TORNILLO WID	Hueco - Mesilla Bolson	1,225	1,225	1,225	1,225	1,225	1,225	1,225
	VINTON	Hueco - Mesilla Bolson	200	400	400	400	400	400	400
		Rio Grande	200						
	COUNTY OTHER	Hueco - Mesilla Bolson	6,278	6,278	6,278	6,278	6,278	6,278	6,278
	MANUFACTURING	Hueco - Mesilla Bolson	9,181	9,181	9,181	9,181	9,181	9,181	9,181
		Rio Grande	0						
	MINING	Hueco - Mesilla Bolson	103	169	169	169	169	169	169
		Other aquifer (Rio Grande Alluvium)	66						
	STEAM ELECTRIC POWER	Hueco - Mesilla Bolson	3,131	3,131	3,131	3,131	3,131	3,131	3,131
	IRRIGATION	Other aquifer (Rio Grande Alluvium)	80,000	136,154	136,154	136,154	136,154	136,154	136,154
		Rio Grande	18,457						
		Indirect Reuse (return flow)	37,697						
	LIVESTOCK	Hueco - Mesilla Bolson	1,742	1,742	1,742	1,742	1,742	1,742	1,742

TABLE 3-2. WATER USER GROUP WATER SUPPLY CAPACITY (Acre-Feet/Year)

Water supply capacity based on current infrastructure, existing contracts, and source supply availability under drought-of-record conditions.

County	Water User Group	Supply Source Name	Infrastructure Capacity per Source	Total Infrastructure Capacity					
				2010	2020	2030	2040	2050	2060
HUDSPETH	SIERRA BLANCA	West Texas Bolson (Salt Basin)	351	351	351	351	351	351	351
	COUNTY OTHER	Hueco Bolson	241	412	412	412	412	412	412
		Bone Spring -Victorio Peak	126						
		Other Aquifer	45						
	MANUFACTURING	Other Aquifer	10	10	10	10	10	10	10
	MINING	Other Aquifer	2	2	2	2	2	2	2
	IRRIGATION	Bone Spring -Victorio Peak	62,843	83,993	83,993	83,993	83,993	83,993	83,993
		Capitan Reef	5,000						
		Other Aquifer (Rio Grande Alluvium)	15,000						
		Upper Rio Grande	298						
		Lower Rio Grande	518						
		Indirect Reuse (return flow)	334						
	LIVESTOCK	Hueco Bolson	88	626	626	626	626	626	626
		Bone Spring -Victorio Peak	31						
		Other Aquifer	438						
		Capitan Reef	12						
		West Texas Bolson (Red Light Draw, Eagle Flat and Green River Valley)	57						
JEFF DAVIS	FORT DAVIS	Igneous	912	912	912	912	912	912	912
	COUNTY OTHER	Igneous	151	162	162	162	162	162	162
		West Texas Bolson (Salt Basin)	8						
		Edwards-Trinity (Plateau)	3						
	IRRIGATION	Igneous	735	3,307	3,307	3,307	3,307	3,307	3,307
		West Texas Bolson (Salt Basin)	2,572						
	LIVESTOCK	Igneous	84	563	563	563	563	563	563
		West Texas Bolson (Salt Basin)	85						
		Edwards-Trinity (Plateau)	141						
		Other Aquifers (Balmorhea Alluvium)	253						

TABLE 3-2. WATER USER GROUP WATER SUPPLY CAPACITY (Acre-Feet/Year)

Water supply capacity based on current infrastructure, existing contracts, and source supply availability under drought-of-record conditions.

County	Water User Group	Supply Source Name	Infrastructure Capacity per Source	Total Infrastructure Capacity					
				2010	2020	2030	2040	2050	2060
PRESIDIO	MARFA	Igneous	4,839	4,839	4,839	4,839	4,839	4,839	4,839
	PRESIDIO	West Texas Bolson (Presidio-Redford)	3,419	3,419	3,419	3,419	3,419	3,419	3,419
	COUNTY OTHER	Other Aquifer	2	94	94	94	94	94	94
		West Texas Bolson (Presidio-Redford)	56						
		Igneous	36						
	MINING	West Texas Bolson (Presidio-Redford)	10	10	10	10	10	10	10
	IRRIGATION	Igneous	1,318	20,522	20,522	20,522	20,522	20,522	20,522
		West Texas Bolson (Presidio-Redford)	4,149						
		West Texas Bolson (Salt Basin)	4,202						
		Lower Rio Grande	10,853						
	LIVESTOCK	Igneous	142	646	646	646	646	646	646
		West Texas Bolson (Presidio-Redford)	110						
		West Texas Bolson (Salt Basin)	142						
		Other Aquifer	252						
TERRELL	SANDERSON	Edwards-Trinity (Plateau)	1,081	1,081	1,081	1,081	1,081	1,081	1,081
	COUNTY OTHER	Edwards-Trinity (Plateau)	39	39	39	39	39	39	39
	MINING	Edwards-Trinity (Plateau)	142	142	142	142	142	142	142
	IRRIGATION	Edwards-Trinity (Plateau)	494	646	646	646	646	646	646
		Lower Rio Grande	152						
	LIVESTOCK	Edwards-Trinity (Plateau)	411	411	411	411	411	411	411

Table 3-3. Water Supplies Available to Each Wholesale Water Provider

Wholesale Water Provider	2010	2020	2030	2040	2050	2060
El Paso County WID #1	173,751	173,751	173,751	173,751	173,751	173,751
El Paso Water Utilities	131,000	131,000	131,000	131,000	131,000	131,000
Lower Valley Water District	6,280	6,280	6,280	6,280	6,280	6,280

3.2 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.

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. The lowest total release from Caballo Dam was 206,081 acre-feet in 1964. The lowest diversion by EPCWID#1 is estimated to be 72,746 acre-feet in 1964, which is not sufficient to meet the needs of water users in the El Paso area. 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.

3.2.1 Rio Grande Treaties and Compact

Water demand related to irrigation use and population growth has affected the River 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.

<u>1906 International Treaty</u> - Under the 1906 International Treaty, the United States is obligated to deliver 60,000 acre-ft 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-ft 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.

<u>Rio Grande Compact</u> - 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 addresses only surface-water apportionment between the three 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.

<u>1944 International Treaty</u> – 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-ft. 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, however, as of the printing of this Plan, Mexico has repaid its entire water debt.

3.2.2 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, while the EPCWID#1 encompasses the project lands in El Paso County, Texas. The Districts deliver water to farmlands in New Mexico and Texas. 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. 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.

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."

3.2.3 Rio Grande Watermaster

A binational commission determines the allocation of Rio Grande water below Ft. Quitman. 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.

3.2.4 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. A more detailed discussion on Rio Grande water quality is provided in Chapter 5.

3.2.5 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.

3.2.6 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 (since salt cedar, in addition to choking the channel, is also a known phreatophyte).

3.2.7 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 miles (117 miles straight line) 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 the following recommendations:

> To have a meaningful impact over much of the study area, a systematic watershed approach is needed. With the reach serving as an international boundary, this would necessarily involve coordination and cooperation between the two nations to be most effective, as well as with the various regulatory and operating agencies. The primary ingredient for affecting significant environmentally beneficial change is effectively managing the water resource. Essential to this is a better understanding of the existing regime, coupled with predictive modeling to evaluate alternative scenarios to inform water managers of the most efficient usage of a scarce resource. The first step should be a meaningful water budget to quantify anticipated water volume, as well as identify/quantify depletions. Volume determination would aid in the evaluation of the reach's response to variations in timing, magnitude, and duration; while depleting elements could be evaluated for modification/ enhancement.
>
> A less encompassing, but potentially more workable, approach could entail selection of some "pilot" or "demonstration" sites for promoting environmental recovery. With appropriate planning, adaptive management and monitoring, the lessons learned at these sites could potentially be applied more broadly and perhaps more economically, throughout the study area. In executing this approach, a first-cut screening of the study reach would be useful – categorizing subreaches by similarities, such as biologic functions exhibited or desired as well as by geomorphic aspects. In selecting pilot project sites, consideration of the origin of adjacent tributaries could foreseeably be a primary 'screening' criterion. For example, incorporation of sediment retention basins on nearby tributaries to limit sediment supply to the mainstem Rio Grande within a demo site subreach could be complicated by the coordination with Mexico if the tributary comes in from that side of the river.
>
> Finally, the 'cluster' of sediment cones noted in Chapter 3 (Figure 5) deserves some discussion. It would be expected that the apparently dramatic transverse elevation features visible in the area of the cluster would cause the river profile to be significantly less uniform within this region of the study area. This, in turn, could be exacerbating the overall sedimentation problems typically seen throughout the study area, assuming it is not a primary influence. It would follow that in formulating alternatives, this area should be considered for channel improvements, since mechanically modifying the channel geometry holds potential for yielding beneficial results.

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.

3.3 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.

3.3.1 Pecos River Compact

The Pecos River Compact provides for the apportionment and diversion of the 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.

3.3.2 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 Senate Bill-1 region, 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-ft of water per year for irrigation purposes.

3.3.3 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.

3.3.4 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 streamflows have 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 saltcedar 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

3.4 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 (14) than in any of the other planning regions (Figure 3-1).

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 Davis Mountains 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 5.

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. An interim TWDB funded project was performed during the current planning period in which new well data, water quality analyses, and aquifer parameters ascertained through pumping tests were developed. The results of this project are provided in a report titled "Groundwater Data Acquisition in Far West Texas", which is accessible at http://www.riocog.org/EnvSvcs/FWTWPG/InterimStudies/Groundwater_Data_Acquisition_Report.pdf. Additional aquifer characterization studies followed as well data was acquired and pumping tests were performed on wells in the Edwards-Trinity (Plateau) Aquifer in Terrell County and the Marathon Aquifer in Brewster County. A summary of these projects is provided in Appendix 3A and the entire report can be viewed at http://www.riocog.org/EnvSvcs/FWTWPG/publishe.htm.

The evaluation of groundwater availability as reported in this Plan 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.

Recharge is a term that encompasses all of the sources by which an aquifer is replenished with water. This includes precipitation, infiltration of water from streams, and irrigation return flow. The arid to semi-arid climate of Far West Texas is a significant limiting factor in the amount of precipitation that can be converted to recharge. Throughout the Region, evaporation typically exceeds precipitation by as much as 70 inches per year. Because most of the rainfall occurs during the hottest months of the year, most of what reaches the ground is lost very quickly to evaporation. In addition to high evaporative losses, a significant amount of moisture is exhausted by desert plants, which have developed highly efficient mechanisms of extracting moisture from soils. Recharge rates vary significantly throughout the Region with fractured bedrock formations at higher elevations receiving the greater amounts and bolson floors receiving the least.

Recoverable storage capacity is the quantity of water contained within void spaces in the aquifer formation that can be extracted by pumping, and is thus a function of the porosity of the saturated portion of the formation. The term "Specific Yield" refers to the percentage of water that will drain, under the force of gravity, from the pore spaces of an aquifer.

Lateral movement includes groundwater that moves laterally into or out of an aquifer from or into adjacent water-bearing formations, and is sometimes referred to as lateral recharge. Lateral movement is a critical calculation in the determination of groundwater availability in aquifers such as the Bone Spring-Victorio Peak.

Aquifer withdrawals primarily occur as pumpage, but also includes natural spring flow. Water-level declines occur in aquifers where pumping withdrawals outpace recharge.

3.4.1 Hueco Bolson

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. There is no fresh water on the eastern edge of the aquifer. 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.

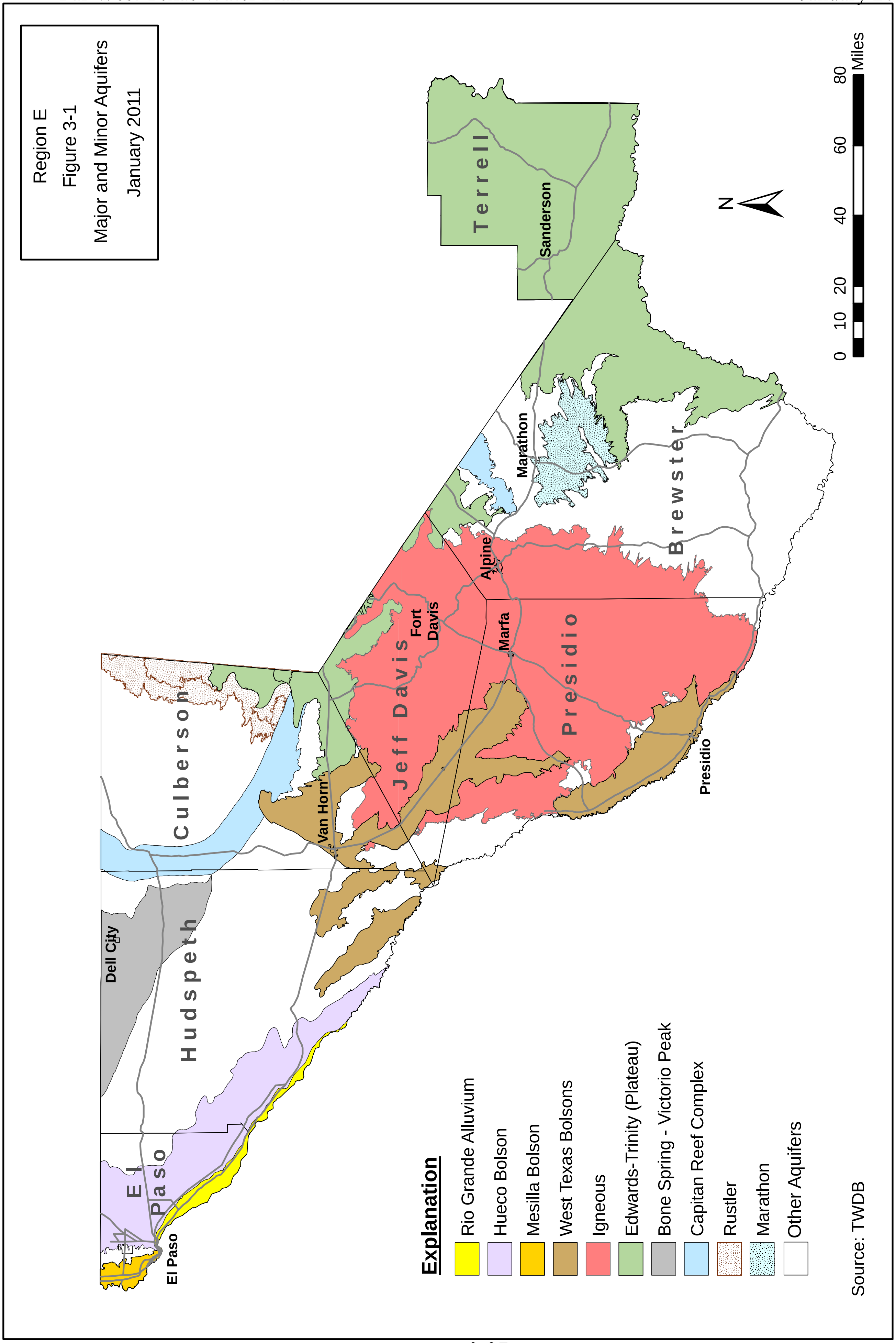

FIGURE 3-1. MAJOR AND MINOR AQUIFERS OF FAR WEST TEXAS

LBG-GUYTON ASSOCIATES

3.4.2 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 this aquifer near Canutillo.

3.4.3 West Texas Bolsons

3.4.3.1 Salt Basin Aquifer

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 four distinct but hydrologically connected areas referred to as “flats” that contain significant quantities of groundwater that is being produced for both municipal and irrigation use. These sub-aquifers include from south to north Ryan, Lobo, Wild Horse, and Michigan Flats.

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.

Lobo Flat lies to the north of Ryan Flat. The basin is bounded by mountains along its western and eastern margins, and is hydrogeologically connected with Wild Horse Flat to the north-northwest. 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 water and stock water for ranches and is also a significant source of irrigation water.

Wild Horse Flat and Michigan Flat lie to the north and northeast, respectively, of Lobo Valley. Lobo Valley is hydrogeologically integrated with the southernmost part of Wild Horse Flat. Mountains bound the Wild Horse-Michigan Flat area along its western, eastern and southeastern margins. The basins extend toward the north, where they are bordered by the Salt Flat Graben.

The Wild Horse-Michigan Flat watershed covers an area of approximately 1,000 mi^2 (Gates and others, 1980). The storage area is estimated to be 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.

3.4.3.2 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. The drainage area in Texas is estimated to be 1,100 mi^2 (Gates and others, 1980). This is an area of approximately 480 mi^2. Based on studies by

Gates and others (1980) and Gabaldon (1991), 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.

3.4.3.3 Green River Valley

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 (Gates and others, 1980), the storage area, however, 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.

3.4.3.4 Red Light Draw

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 (Gates and others, 1980) 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.

3.4.3.5 Eagle Flat

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 (Gates and others, 1980), 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 (Gates and others, 1980; Darling and others, 1994; Darling, 1997). 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.

3.4.4 Bone Spring-Victorio Peak Aquifer

The Bone Spring-Victorio Peak Aquifer underlies the Dell Valley area of northeastern Hudspeth County (Figure 3-1). Dell Valley lies 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 (Ashworth, 1994).

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.

There are four principal components of recharge to the Bone Spring-Victorio Peak Aquifer (Ashworth, 1994):

- 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.

3.4.5 Igneous Aquifer

The Davis Mountains 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.

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.

3.4.6 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.

3.4.7 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 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.

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.

3.4.8 Marathon Aquifer

The Marathon Aquifer is located entirely within the north-central area of Brewster County. 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. Figure 3-1 delineates the 390-mi^2 area in which the rocks that make up the Marathon aquifer are exposed in Brewster County. Existing water wells have penetrated up to 900 feet of the aquifer, however most wells are significantly shallower. Groundwater occurs under unconfined conditions in crevices, joints and cavities. The most significant water-bearing formation of the aquifer is the Marathon Limestone (early Ordovician age). Artesian conditions are common in areas where the Paleozoic rocks are buried beneath younger formations. The depth to groundwater is generally less than 150 feet, and depths less than 50 feet are not uncommon. Most wells are generally less than 250 feet deep (DeCook, 1961; TWDB, 1997).

3.4.9 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 (TWDB, 1997).

3.4.10 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 recoverable groundwater having less than 2,500 mg/l dissolved solids.

Groundwater contained within the shallow 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 Rio Grande Alluvium. In addition, the Horizon Regional MUD is currently pumping approximately 3,360 acre-feet per year from the alluvial aquifer.

3.4.11 Other Groundwater Resources

Also shown in Figure 3-1 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.

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. 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.

The 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. The Plateau, however, has not been sufficiently evaluated by hydrogeologists to warrant definite conclusions regarding its status as a potential source of groundwater at this time. Relatively few exploration wells have been drilled on the Plateau. Consequently, factors such as hydrostratigraphy and important hydraulic parameters (e.g., porosity, hydraulic conductivity and transmissivity) are largely unknown.

3.4.12 Groundwater Conditions in Municipal Well Fields

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 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 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.

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 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.

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 ft. 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 ft. 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 total decrease in the potentiometric surface beneath Ciudad Juarez has been significant enough to cause the cone beneath Ciudad Juarez to migrate north of the Rio Grande. 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.

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.

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 Davis Mountains 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 has also looked at other areas in the vicinity of Fort Davis for future well development.

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 the Town of Valentine.

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 Davis Mountains 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 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.

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.

3.4.13 Groundwater Exports

Jeff Davis is the only county from which water is exported to other areas outside of its borders. As shown by the table below, from 2004 through 2008 the City of Alpine pumped an average of 858 acre-feet per year from five wells in the Musquiz well field in southern Jeff Davis County. All other exports go to Reeves County. From 2004 through 2008 the City of Balmorhea and the Madera Valley WSC extracted an average of 91 and 86 acre-feet per year 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.

Received By	Receiving County	Source	Amount (Acre-ft/Yr)	Remarks
City of Alpine	Brewster	Igneous Aquifer	858	Pumpage from five wells in Musquiz well field
City of Balmorhea	Reeves	Balmorhea Alluvium	95	Pumpage from one well
Madera Valley WSC	Reeves	Balmorhea Alluvium	101	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

3.5 REUSE

El Paso 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. The supply from the direct reuse program is expected to increase from 5,000 acre-ft per year in 2000 to over 23,000 acre-ft per year by 2060.

APPENDIX 3A

GROUNDWATER DATA ACQUISITION AND ANALYSIS FOR THE MARATHON AND EDWARDS-TRINITY (PLATEAU) AQUIFERS

GROUNDWATER DATA ACQUISITION AND ANALYSIS FOR THE MARATHON AND EDWARDS-TRINITY (PLATEAU) AQUIFERS

Previous recommendations were made in Chapter 8 of the 2006 Far West Texas Water Plan for additional groundwater data on the Marathon and Edwards-Trinity (Plateau) Aquifers to improve and expand the groundwater database to be used to better quantify water availability from these two aquifers in the Far West Texas Region. As a result, two special study projects were scoped in Brewster and Terrell Counties to assist with data compilation to be utilized in the future development or enhancement of Groundwater Availability Models (GAM). These efforts included identifying and surveying new well data, and conducting pumping tests to help determine aquifer parameters. The entire report can be viewed at http://www.riocog.org/EnvSvcs/FWTWPG/publishe.htm.

Local officials in Brewster and Terrell Counties were sought out to assist with identifying candidate wells and getting access from well owners. In Brewster County, Conrad Arriola, general manager of the Brewster County Groundwater Conservation District, provided assistance with identifying and contacting well owners in the Marathon Aquifer area. Daniel Eaton of Marathon was also helpful in assisting with some of the pumping tests near the Town of Marathon. In Terrell County, Tom Lowrance, general manager for the Terrell County Water Control and Improvement District #1, was instrumental in getting access to public supply wells near the town of Sanderson.

The acquisition of new well data integrated identification and field survey of new wells that currently are not contained within the TWDB groundwater database and the addition of new or updated data to existing wells in the database. Initial information on candidate wells were obtained from driller's reports filed with the Texas Department of Licensing and Regulation or from other previous state inventory work. Current TWDB field well inventory forms were obtained and utilized in recording data generated from the field visits. Each well visited was photographed and their locations were measured with a global position system (GPS). During the well visit, any additional information was tabulated and a water level was measured where possible. Communication with TWDB staff was maintained to insure that appropriate data was collected and that there was no duplication of board staff activities. If the inventoried well did not have a previously dedicated state well number then one was assigned by the TWDB.

The wells selected for pumping tests require that those wells be capable of being monitored for both water-level decline (feet) and pumping rate (gallons per minute). Those wells that have an available observation well give an added bonus of being able to determine what is happening to the cone of depression in the aquifer at distance from the pumping well, which gives added validity to the test results.

The Marathon Aquifer is one of the smallest designated aquifers in areal extent and occurs exclusively in northern Brewster County. The Town of Marathon derives its municipal water supply from this aquifer. Thirteen Marathon Aquifer wells were field surveyed. Most of these wells were not previously inventoried by the TWDB and, therefore, represent new wells added to the TWDB groundwater database. Pumping tests were performed on four of the wells with larger production capabilities.

The Edwards-Trinity (Plateau) Aquifer in Terrell County represents only a small portion of one of the largest aquifers in areal extent in Texas. The Town of Sanderson derives its water supply from this aquifer. A groundwater conservation district does not exist in Terrell County, which makes it difficult to locate current well owners, many of which have permanent residences outside the county. As a result, locations of these wells were not verified in the field.

Forty-four Edwards-Trinity (Plateau) Aquifer wells were drilled after the year 2000 and generally represent new well data in the County. Locations and details regarding the wells as reported by water well drillers are listed. This information was not field-verified. Eleven wells operated by the Terrell County Water Control and Improvement District #1 were utilized for pumping test analysis and database update. Seven individual pumping tests with observation wells were performed on these wells.

CHAPTER 4

WATER MANAGEMENT STRATEGIES

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4.1 INTRODUCTION

Chapter 4 contains a comparison of projected water demands for each municipality and non-municipal water user group from Chapter 2, and water supplies available to meet those demands from Chapter 3. Water supply management strategy recommendations are then made for those water use groups that have water supply deficits based on the comparison between demand and supply. In the development of water management strategies, existing water rights, water contracts, and option agreements are recognized and fully protected. The State Legislature mandates that any project that requires a state permit or desires state funding must be described in terms of a strategy in the regional water plan in which it is to appear. A socioeconomic impact of unmet water needs in Far West Texas analysis prepared by the Texas Water Development Board is provided in Appendix 4A.

4.2 WATER SUPPLY AND DEMAND COMPARISON

Table 4-1 compares available water user group supplies (Table 3-2) with their corresponding future projected demands (Table 2-2). Water supply deficits are identified where the demand exceeds the supply. Water supply deficits are identified for a number of municipalities, manufacturing use, and steam power electric generation in El Paso County, and for irrigation supply use in El Paso and Hudspeth Counties. Sections 4.4 through 4.8 provide recommended strategies to meet these identified deficits. Although a water supply deficit is not projected for the City of Marfa, strategies are provided for the City in recognition of projects that are currently in the planning and design phase.

4.3 STRATEGY EVALUATION PROCEDURE

A specific process was used in the selection and evaluation of strategies and is summarized in the flow chart illustrated in Figure 4-1. The process starts with a consideration of potentially feasible strategies to meet the needs of each entity or category with a supply deficit. From this list, the Far West Texas Water Planning Group (FWTWPG) selects specific strategies for further feasibility and impact analysis.

The strategy evaluation procedure is designed to provide a side-by-side comparison such that all strategies can 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) (see Table 4-3)
- Environmental impacts (see Table 4-4)
- Impacts to agricultural resources
- Impact to natural resources
- Recreational impacts

Table 4-2 provides a comparative listing of all potentially feasible strategies that the FWTWPG subsequently recommends in total for inclusion in the 2011 Plan. No "alternative" strategies are recommended by the FWTWPG.

Water planning requires an accurate assessment of the amount of water that is currently being consumed. 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. A summary of the first audit, An Analysis of Water Loss as Reported by Public Water Suppliers – 2007 (http://www.twdb.state.tx.us/RWPG/rpgm_rpts/0600010612_WaterLossinTexas.pdf) was provided to the Far West Texas Water Planning Group (FWTWPG) for consideration in developing water supply management strategies. The FWTWPG acknowledges the value of this important planning tool, but identified apparent errors in some of the data. The report does offer the recognition that "as utilities refine their water audits, reducing balancing adjustments and improving real loss estimates, it is expected that water loss data reported from the next round of water audits will be more useful for planning purposes than the current water loss data. Based on this concern, the FWTWPG chose to not use the supplied data for this current Plan, but looks forward to the next improved water loss audit survey.

To adequately consider the unique challenges faced by municipal and industrial water users in El Paso County, an integrated approach was used to establish a feasible strategy capable of identifying sufficient future supplies to meet the needs of El Paso Water Utilities (EPWU), the largest wholesale water provider in the county. In developing the *2006 Far West Texas Water Plan*, six separate approaches were considered that combined various potential surface water and groundwater sources at variable supply rates and times of implementation. The FWTWPG compared the six integrated strategies and selected the strategy termed the *"Balanced Approach with Moderate Increase in Surface Water"* for the 2006 Plan. A detailed report was prepared containing all six strategies and titled Integrated Water Management Strategies for the City and County of El Paso. For this 2011 Plan, the integrated approach to municipal and industrial water supplies in El Paso County was updated as described in Section 4.4.Other non-integrated municipal strategies are discussed in Section 4.5. 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 Section 4.6. Included in Appendix 4B are other projects for future consideration but not listed as "alternative" strategies. Strategies or project proposals for which the FWTWPG received insufficient data are not included in this Plan.

Cost evaluations for all strategies (Table 4-3) include capital cost, debt service, and annual operating and maintenance (O&M) expenses. Capital costs are estimated based on September 2008 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.

TABLE 4-1. WATER SUPPLY CAPACITY AND WATER DEMAND COMPARISON DURING DROUGHT-OF-RECORD CONDITIONS (Acre-Feet/Year)(Shaded areas designate shortages)

County/ Water Use Category	Supply / Demand	2010	2020	2030	2040	2050	2060
Brewster County							
Alpine	S	4,864	4,864	4,864	4,864	4,864	4,864
	D	1,791	1,888	1,917	1,928	2,014	2,034
		3,073	**2,976**	**2,947**	**2,936**	**2,850**	**2,830**
County- Other	S	455	455	455	455	455	455
	D	451	448	441	432	431	432
		4	**7**	**14**	**23**	**24**	**23**
Manufacturing	S	4	4	4	4	4	4
	D	4	4	4	4	4	4
		0	**0**	**0**	**0**	**0**	**0**
Mining	S	696	696	696	696	696	696
	D	576	554	546	539	532	523
		120	**142**	**150**	**157**	**164**	**173**
Irrigation	S	8,790	8,790	8,790	8,790	8,790	8,790
	D	1,622	1,613	1,605	1,596	1,588	1,580
		7,168	**7,177**	**7,185**	**7,194**	**7,202**	**7,210**
Livestock	S	798	798	798	798	798	798
	D	707	707	707	707	707	707
		91	**91**	**91**	**91**	**91**	**91**
Culberson County							
Van Horn	S	2,084	2,084	2,084	2,084	2,084	2,084
	D	839	890	907	905	901	901
		1,245	**1,194**	**1,177**	**1,179**	**1,183**	**1,183**
County- Other	S	78	78	78	78	78	78
	D	74	78	78	77	76	76
		4	**0**	**0**	**1**	**2**	**2**
Mining	S	2,161	2,161	2,161	2,161	2,161	2,161
	D	1,514	1,560	1,577	1,594	1,610	1,632
		647	**601**	**584**	**567**	**551**	**529**
Irrigation	S	46,759	46,759	46,759	46,759	46,759	46,759
	D	46,759	45,758	44,779	43,821	42,883	41,965
		0	**1,001**	**1,980**	**2,938**	**3,876**	**4,794**
Livestock	S	466	466	466	466	466	466
	D	344	344	344	344	344	344
		122	**122**	**122**	**122**	**122**	**122**

County/ Water Use Category	Supply / Demand	2010	2020	2030	2040	2050	2060
El Paso County							
Anthony	S	3,065	3,065	3,065	3,065	3,065	3,065
	D	719	826	924	1,004	1,089	1,182
		2,346	**2,239**	**2,141**	**2,061**	**1,976**	**1,883**
Clint	S	276	276	276	276	276	276
	D	270	268	268	267	267	267
		6	**8**	**8**	**9**	**9**	**9**
City of El Paso (EPWU)	S	127,567	127,567	127,567	127,567	127,567	127,567
	D	92,829	104,503	114,750	123,586	132,423	141,260
		34,738	**23,064**	**12,817**	**3,981**	**-4,856**	**-13,693**
El Paso County WCID #4	S	4,445	4,445	4,445	4,445	4,445	4,445
	D	1,583	2,124	2,587	2,992	3,389	3,813
		2,862	**2,321**	**1,858**	**1,453**	**1,056**	**632**
Fort Bliss	S	21,694	21,694	21,694	21,694	21,694	21,694
	D	10,953	12,359	12,359	12,359	12,359	12,359
		10,741	**9,335**	**9,335**	**9,335**	**9,335**	**9,335**
Horizon Regional MUD	S	3,920	3,920	3,920	3,920	3,920	3,920
	D	3,593	5,527	7,224	8,684	10,165	11,646
		327	**-1,607**	**-3,304**	**-4,764**	**-6,245**	**-7,726**
Lower Valley Water District	S	1,121	1,121	1,121	1,121	1,121	1,121
	D	1,121	1,726	2,282	2,725	3,199	3,672
		0	**-605**	**-1,161**	**-1,604**	**-2,078**	**-2,551**
San Elizario	S	1,924	1,924	1,924	1,924	1,924	1,924
	D	1,924	2,858	3,718	4,405	5,138	5,871
		0	**-934**	**-1,794**	**-2,481**	**-3,214**	**-3,947**
Socorro	S	2,959	2,959	2,959	2,959	2,959	2,959
	D	2,959	3,466	3,977	4,361	4,795	5,230
		0	**-507**	**-1,018**	**-1,402**	**-1,836**	**-2,271**
El Paso County Tornillo WID	S	1,225	1,225	1,225	1,225	1,225	1,225
	D	534	818	1,078	1,287	1,509	1,730
		691	**407**	**147**	**-62**	**-284**	**-505**
Vinton	S	400	400	400	400	400	400
	D	399	614	798	962	1,126	1,291
		1	**-214**	**-398**	**-562**	**-726**	**-891**
County- Other	S	6,278	6,278	6,278	6,278	6,278	6,278
	D	6,278	9,392	11,903	13,867	15,862	18,154
		0	**-3,114**	**-5,625**	**-7,589**	**-9,584**	**-11,876**
Manufacturing	S	9,181	9,181	9,181	9,181	9,181	9,181
	D	9,181	9,994	10,692	11,367	11,941	12,855
		0	**-813**	**-1,511**	**-2,186**	**-2,760**	**-3,674**
Mining	S	169	169	169	169	169	169
	D	157	153	151	149	147	146
		12	**16**	**18**	**20**	**22**	**23**
Steam Electric Power	S	3,131	3,131	3,131	3,131	3,131	3,131
	D	3,131	6,937	8,111	9,541	11,284	13,410
		0	**-3,806**	**-4,980**	**-6,410**	**-8,153**	**-10,279**
Irrigation	S	136,154	136,154	136,154	136,154	136,154	136,154
	D	247,111	242,798	240,848	232,380	228,579	224,840
		-110,957	**-106,644**	**-104,694**	**-96,226**	**-92,425**	**-88,686**
Livestock	S	1,742	1,742	1,742	1,742	1,742	1,742
	D	1,742	1,742	1,742	1,742	1,742	1,742
		0	**0**	**0**	**0**	**0**	**0**

County/ Water Use Category	Supply / Demand	2010	2020	2030	2040	2050	2060
Hudspeth County							
Sierra Blanca	S	351	351	351	351	351	351
	D	123	130	134	132	131	131
		228	**221**	**217**	**219**	**220**	**220**
County- Other	S	412	412	412	412	412	412
	D	287	297	301	288	284	284
		125	**115**	**111**	**124**	**128**	**128**
Manufacturing	S	10	10	10	10	10	10
	D	2	2	2	2	2	2
		8	**8**	**8**	**8**	**8**	**8**
Mining	S	2	2	2	2	2	2
	D	1	1	1	1	1	1
		1	**1**	**1**	**1**	**1**	**1**
Irrigation	S	83,993	83,993	83,993	83,993	83,993	83,993
	D	182,627	178,840	175,132	171,501	167,945	164,463
		-98,634	**-94,847**	**-91,139**	**-87,508**	**-83,952**	**-80,470**
Livestock	S	626	626	626	626	626	626
	D	613	613	613	613	613	613
		13	**13**	**13**	**13**	**13**	**13**
Jeff Davis County							
Fort Davis	S	912	912	912	912	912	912
	D	343	403	444	484	524	565
		569	**509**	**468**	**428**	**388**	**347**
County- Other	S	162	162	162	162	162	162
	D	162	159	155	151	150	150
		0	**3**	**7**	**11**	**12**	**12**
Irrigation	S	3,307	3,307	3,307	3,307	3,307	3,307
	D	591	587	584	581	578	574
		2,716	**2,720**	**2,723**	**2,726**	**2,729**	**2,733**
Livestock	S	563	563	563	563	563	563
	D	508	508	508	508	508	508
		55	**55**	**55**	**55**	**55**	**55**
Presidio County							
Marfa	S	4,839	4,839	4,839	4,839	4,839	4,839
	D	886	969	1,060	1,049	1,042	1,042
		3,953	**3,870**	**3,779**	**3,790**	**3,797**	**3,797**
Presidio	S	3,419	3,419	3,419	3,419	3,419	3,419
	D	1,039	1,255	1,458	1,642	1,727	1,781
		2,380	**2,164**	**1,961**	**1,777**	**1,692**	**1,638**
County- Other	S	94	94	94	94	94	94
	D	81	66	52	42	37	34
		13	**28**	**42**	**52**	**57**	**60**
Mining	S	10	10	10	10	10	10
	D	7	7	7	7	7	7
		3	**3**	**3**	**3**	**3**	**3**
Irrigation	S	20,522	20,522	20,522	20,522	20,522	20,522
	D	20,304	19,906	19,515	19,132	18,757	18,390
		218	**616**	**1,007**	**1,390**	**1,765**	**2,132**
Livestock	S	646	646	646	646	646	646
	D	622	622	622	622	622	622
		24	**24**	**24**	**24**	**24**	**24**

County/ Water Use Category	Supply / Demand	2010	2020	2030	2040	2050	2060
Terrell County							
Sanderson	S	1,081	1,081	1,081	1,081	1,081	1,081
	D	200	205	201	198	197	197
		881	**876**	**880**	**883**	**884**	**884**
County- Other	S	39	39	39	39	39	39
	D	38	39	38	37	37	37
		1	**0**	**1**	**2**	**2**	**2**
Mining	S	142	142	142	142	142	142
	D	142	142	142	142	142	142
		0	**0**	**0**	**0**	**0**	**0**
Irrigation	S	646	646	646	646	646	646
	D	78	77	75	73	72	70
		568	**569**	**571**	**573**	**574**	**576**
Livestock	S	411	411	411	411	411	411
	D	307	307	307	307	307	307
		104	**104**	**104**	**104**	**104**	**104**

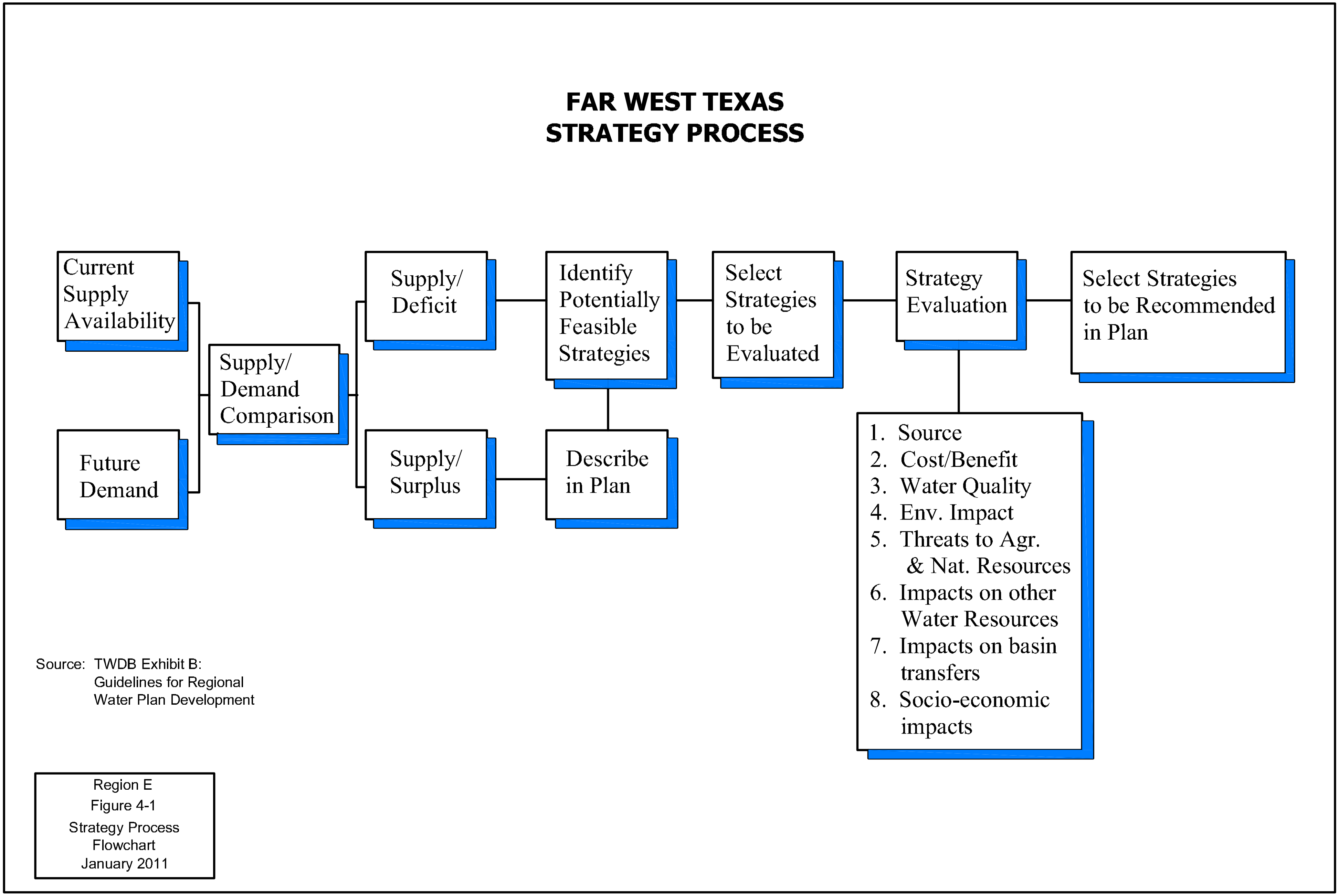

FIGURE 4-1. STRATEGY PROCESS FLOW CHART

LBG-GUYTON ASSOCIATES

TABLE 4-2. SUMMARY OF RECOMMENDED WATER MANAGEMENT STRATEGY EVALUATIONS

(All strategies are in the Rio Grande Basin)

Water User Group	County Used	Strategy	Strategy ID	Source	Strategy Supply (Acre-Feet/Year)*						Total Capital Cost (Table 4-3)	Quality **	Reliability***	Average Environmental Factors (Table 4-4)	Strategy Impacts****			
					2010	2020	2030	2040	2050	2060					Water Resources (1-5)	Agricultural Resources (1-5)	Natural Resources (1-5)	Ecologically Unique Stream Segments (1-5)
City of El Paso (EPWU)	El Paso	IWMS - Direct reuse	E-1	Treated EPWU blended sources		2,000	4,000	6,000	6,000	6,000	$25,257,000	2	1	1.5	1	2	2	2
City of El Paso (EPWU)	El Paso	IWMS - Conservation	E-2	NA		3,000	7,000	11,000	16,000	22,000	NA	NA	NA	2	NA	NA	NA	2
City of El Paso (EPWU)	El Paso	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	2	2	2	2	2	2	2
City of El Paso (EPWU)	El Paso	IWMS - Desalination of agricultural drain water	E-4	Treated Agricultural Drain Water		2,700	2,700	2,700	2,700	2,700	$16,675,000	2	1	2.25	3	2	2	2
City of El Paso (EPWU)	El Paso	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	2	2	2	2	3	2	2
City of El Paso (EPWU)	El Paso	IWMS - Import from Dell Valley	E-6	Bone Spring-Victorio Peak Aquifer					10,000	20,000	$214,113,000	2	1	2.25	2	4	2	2
City of El Paso (EPWU)	El Paso	IWMS - Import from Diablo Farms	E-7	Capitan Reef Aquifer				10,000	10,000	10,000	$245,506,000	1	1	2.25	3	3	2	2
Lower Valley Water District (El Paso County Other)	El Paso	Purchase water from LVWD	E-10	EPWU blended sources		605	1,161	1,604	2,078	2,551	$0	1	2	2	2	2	2	2
San Elizario	El Paso	Purchase water from LVWD	E-11	EPWU blended sources		934	1,794	2,481	3,214	3,947	$0	1	2	2	2	2	2	2
Socorro	El Paso	Purchase water from LVWD	E-12	EPWU blended sources		507	1,018	1,402	1,836	2,271	$0	1	2	2	2	2	2	2
Fort Bliss	El Paso	Purchase water from EPWU	E-9	EPWU blended sources	3,376	8,992	8,998	8,998	9,004	9,004	$0	1	2	2	2	2	2	2
Vinton	El Paso	Purchase water from EPWU	E-14	EPWU blended sources		214	398	562	726	891	$0	1	2	2	2	2	2	2
El Paso County Other	El Paso	Purchase Water from EPWU	E-15	EPWU blended sources		3,114	5,625	7,589	9,584	11,876	$0	1	1	2.25	2	2	2	2
Manufacturing	El Paso	Purchase water from EPWU	E-16	EPWU blended sources		813	1,511	2,186	2,760	3,674	$0	1	2	2	2	2	2	2
Steam Electric Power	El Paso	Purchase water from EPWU	E-17	EPWU blended sources		3,806	4,980	6,410	8,153	10,279	$0	1	2	2	2	2	2	2
Horizon Regional MUD	El Paso	Additional wells and desalination plant expansions.	E-8	Rio Grande Alluvium		1,527	3,224	4,684	6,165	7,646	$34,344,000	1	2	2.25	3	2	2	2
El Paso County Tornillo WID	El Paso	Additional wells	E-13	Hueco Bolson Aquifer		175	175	350	350	350	$1,006,762	1	1	2.25	3	2	2	2
El Paso County Tornillo WID	El Paso	Arsenic treatment facility	E-23	Hueco Bolson Aquifer		276	276	276	276	276	$1,996,232	1	1	2.25	3	2	2	2
Irrigation (EPCWID#1)	El Paso	Irrigation scheduling (Conservation)	E-18	Upper Rio Grande	1,740	1,740	1,740	1,740	1,740	1,740	$0	3	2	2	1	2	2	2
		Water district delivery systems	E-19	Upper Rio Grande	25,000	25,000	25,000	25,000	25,000	25,000	$147,635,869	3	2	2	1	2	2	2
		Tailwater reuse (Conservation)	E-20	Upper Rio Grande	1,723	1,723	1,723	1,723	1,723	1,723	$0	3	2	2	1	2	2	2
Irrigation (HCUWCD#1)	Hudspeth	Irrigation scheduling (Conservation)	E-21	Bone Spring-Victorio Peak Aquifer	3,535	3,535	3,535	3,535	3,535	3,535	$0	3	2	2	1	2	2	2
		Tailwater reuse (Conservation)	E-22	Bone Spring-Victorio Peak Aquifer	589	589	589	589	589	589	$0	3	2	2	1	2	2	2
Irrigation (HCCRD#1)	Hudspeth	No feasible strategy	NA	None	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
City of Marfa	Presidio	Additional 1 well	E-24	Igneous Aquifer		500	500	500	500	500	$702,770	1	1	2.25	2	2	2	2

* Strategy Supply:Supply is the "Needs" volume from Table 4-1 for all entities except Irrigation. Irrigation supply in El Paso and Hudspeth Counties is from Table 26 in the 2009 irrigation strategy evaluation report.

** Quality range: 1= Meets safe drinking-water standards; 2=Must be treated or mixed to meet safe drinking-water standards; 3=Usable for irrigation.

*** Reliability range: 1=Sustainable; 2=Interruptible during droughts; 3=Non-sustainable.

**** Strategy impact range: 1=positive; 2=no new; 3=minimal negative; 4=moderate negative; 5=significant negative.

Table 4-3. SUMMARY OF RECOMMENDED WATER MANAGEMENT STRATEGY COST

Water User Group	County Used	Strategy	Strategy ID	Total Capital Cost*	Total Annual Cost						Cost per Acre-Foot/Year					
					2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
City of El Paso (EPWU)	El Paso	IWMS - Direct reuse	E-1	$25,257,000		$1,075,300	$2,150,300	$3,225,000	$2,615,300	$2,001,300		$538	$538	$538	$436	$334
City of El Paso (EPWU)	El Paso	IWMS - Conservation	E-2	NA	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000		$333	$143	$91	$63	$45
City of El Paso (EPWU)	El Paso	IWMS - Recharge of groundwater with treated surface water	E-3	$14,625,000		$2,710,000	$2,710,000	$2,710,000	$1,648,000	$1,648,000		$542	$542	$542	$330	$330
City of El Paso (EPWU)	El Paso	IWMS - Desalination of agricultural drain water	E-4	$16,675,000		$2,512,000	$2,512,000	$2,512,000	$1,286,000	$1,286,000		$930	$930	$930	$476	$476
City of El Paso (EPWU)	El Paso	IWMS - Conjunctive use with additional surface water	E-5	$140,238,000		$8,353,000	$14,114,000	$18,210,000	$12,091,000	$10,490,000			$941	$911	$605	$525
City of El Paso (EPWU)	El Paso	IWMS - Import from Dell Valley	E-6	$214,113,000					$15,291,000	$26,177,000					$1,529	$1,309
City of El Paso (EPWU)	El Paso	IWMS - Import from Diablo Farms	E-7	$245,506,000				$23,530,000	$23,530,000	$23,530,000				$2,353	$2,353	$2,353
Lower Valley Water District** (El Paso County Other)	El Paso	Purchase water from LVWD	E-10	$0		$0	$0	$0	$0	$0		$0	$0	$0	$0	$0
San Elizario**	El Paso	Purchase water from LVWD	E-11	$0		$0	$0	$0	$0	$0		$0	$0	$0	$0	$0
Socorro**	El Paso	Purchase water from LVWD	E-12	$0		$0	$0	$0	$0	$0		$0	$0	$0	$0	$0
Fort Bliss**	El Paso	Purchase water from EPWU	E-9	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Vinton**	El Paso	Purchase water from EPWU	E-14	$0		$0	$0	$0	$0	$0		$0	$0	$0	$0	$0
County Other**	El Paso	Purchase water from EPWU	E-15	$0		$0	$0	$0	$0	$0		$0	$0	$0	$0	$0
Manufacturing**	El Paso	Purchase water from EPWU	E-16	$0		$0	$0	$0	$0	$0		$0	$0	$0	$0	$0
Steam Electric Power**	El Paso	Purchase water from EPWU	E-17	$0		$0	$0	$0	$0	$0		$0	$0	$0	$0	$0
Horizon Regional MUD	El Paso	Additional wells and desalination	E-8	$34,344,000		$1,790,000	$3,020,000	$3,635,000	$4,444,000	$4,359,000		$814	$686	$661	$673	$566
El Paso County Tornillo WID	El Paso	Additional wells	E-13	$1,006,762		$5,000	$5,000	$10,000	$10,000	$10,000		$29	$29	$29	$29	$23
El Paso County Tornillo WID	El Paso	Arsenic treatment facility	E-23	$1,996,232		$9,413	$9,413	$9,413	$9,413	$9,413		$34	$34	$34	$34	$34
Irrigation (EPCWID#1)	El Paso	Irrigation scheduling (Conservation)	E-18	$0		$96,000	$96,000	$96,000	$96,000	$96,000		$55	$55	$55	$55	$55
		Water district delivery systems	E-19	$147,635,869		$202,261	$202,261	$202,261	$202,261	$202,261		$339	$339	$339	$339	$339
		Tailwater reuse (Conservation)	E-20	$0		$910,800	$910,800	$910,800	$910,800	$910,800		$529	$529	$529	$529	$529
Irrigation (HCUWCD#1)	Hudspeth	Irrigation scheduling (Conservation)	E-21	$0		$270,570	$270,570	$270,570	$270,570	$270,570		$74	$74	$74	$74	$74
		Tailwater reuse (Conservation)	E-22	$0		$194,063	$194,063	$194,063	$194,063	$194,063		$329	$329	$329	$329	$329
Irrigation (HCCRD#1)	Hudspeth	No feasible strategy	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
City of Marfa	Presidio	Additional 1 well	E-24	$702,770		$5,000	$5,000	$5,000	$5,000	$5,000		$10	$10	$10	$10	$10

* Total Capital Cost are estimated based on September 2008 US dollars.

** EPWU contract sales price per acre-foot
Price escalates 3% per year
O&M included in contracted price

Table 4-4. SUMMARY OF RECOMMENDED WATER MANAGEMENT STRATEGY ENVIRONMENTAL ASSESSMENTS

Water User Group	County Supply Used	County Supply Origin	Strategy	Strategy ID	**Total Number of Rare, Threatened & Endangered Species in County (species impacted is undetermined)	Environmental Impact Factors *						Area Impacted and Resulting Conditions
						Envir. Water Needs	Habitat	Cultural Resources	Envir. Water Quality	Bays & Estuaries ***	Overall Envir. Impact	
						(1-5)	(1-5)	(1-5)	(1-5)	NA	(1-5)	
City of El Paso (EPWU)	El Paso	El Paso	IWMS - Direct reuse	E-1	52	1	1	2	2		1.5	Undetermined area temporarily impacted by pipeline construction. Landscape irrigation creates greener space.
City of El Paso (EPWU)	El Paso	El Paso	IWMS - Conservation	E-2	52	2	2	2	2		2	Creates less stress on existing water sources.
City of El Paso (EPWU)	El Paso	El Paso	IWMS - Recharge of groundwater with treated surface water	E-3	52	2	1	2	2		1.75	Four half-acre freshwater wetlands created.
City of El Paso (EPWU)	El Paso	El Paso	IWMS - Desalination of agricultural drain water	E-4	52	2	2	2	2		2	Plants constructed at existing facilities. Uses only temporary high-salt drain water.
City of El Paso (EPWU)	El Paso	El Paso	IWMS - Conjunctive use with additional surface water	E-5	52	2	2	2	2		2	Will require additional treatment plant facility (20 acres). 5,000 acres impacted by change in use from agricultural to municipal supply use.
City of El Paso (EPWU)	El Paso	Hudspeth	IWMS - Import from Dell Valley	E-6	52	2	3	2	2		2.25	460 acres impacted by right-of-way. 9,500 acres may be converted from agricultural to municipal supply use. Will require desal plant and disposal facility.
City of El Paso (EPWU)	El Paso	Cu/Hu	IWMS - Import from Diablo Farms	E-7	52	2	3	2	2		2.25	81 acres temporarily impacted by right-of-way. 28,000 acres converted from agricultural to municipal supply use. Land use changed from cultivated to rangeland.
Lower Valley Water District (El Paso County Other)	El Paso	EP/Cu/Hu	Purchase water from LVWD	E-10	52	2	2	2	2		2	Causes no change in existing conditions.
San Elizario	El Paso	EP/Cu/Hu	Purchase water from LVWD	E-11	52	2	2	2	2		2	Causes no change in existing conditions.
Socorro	El Paso	EP/Cu/Hu	Purchase water from LVWD	E-12	52	2	2	2	2		2	Causes no change in existing conditions.
Fort Bliss	El Paso	EP/Cu/Hu	Purchase water from EPWU	E-9	52	2	2	2	2		2	Causes no change in existing conditions.
Vinton	El Paso	EP/Cu/Hu	Purchase water from EPWU	E-14	52	2	2	2	2		2	Causes no change in existing conditions.
El Paso County Other	El Paso	EP/Cu/Hu	Purchase Water from EPWU	E-15	52	2	3	2	2		2.25	Undetermined area temporarily impacted by pipeline construction.
Manufacturing	El Paso	EP/Cu/Hu	Purchase water from EPWU	E-16	52	2	2	2	2		2	Causes no change in existing conditions.
Steam Electric Power	El Paso	EP/Cu/Hu	Purchase water from EPWU	E-17	52	2	2	2	2		2	Causes no change in existing conditions.
Horizon Regional MUD	El Paso	El Paso	Additional wells and desalination plant expansions.	E-8	52	2	3	2	2		2.25	Temporary land disturbance during drilling of wells and plant expansion. Less than 10 acres impacted.
El Paso County Tornillo WID	El Paso	El Paso	Additional wells	E-13	52	2	3	2	2		2.25	Temporary land disturbance during drilling of well and pipeline construction. Less than 5 acres impacted.
El Paso County Tornillo WID	El Paso	El Paso	Arsenic treatment facility	E-23	52	2	3	2	2		2.25	Temporary land disturbance during construction. Less than 5 acres impacted.
Irrigation (EPCWID#1)	El Paso	El Paso	Irrigation scheduling (Conservation)	E-18	52	2	2	2	2		2	Causes no change in existing conditions.
			Water district delivery systems	E-19	52	3	3	2	2		2.5	Temporary land disturbance during pipelines construction. Open water sources will be removed. Undetermined area impacted.
			Tailwater reuse (Conservation)	E-20	52	2	2	2	2		2	Causes no change in existing conditions.
Irrigation (HCUWCD#1)	Hudspeth	Hudspeth	Irrigation scheduling (Conservation)	E-21	64	2	2	2	2		2	Causes no change in existing conditions.
			Tailwater reuse (Conservation)	E-22	64	2	2	2	2		2	Causes no change in existing conditions.
Irrigation (HCCRD#1)	Hudspeth	Hudspeth	No feasible strategy	NA	64	NA	NA	NA	NA		NA	NA
City of Marfa	Presidio	Presidio	Additional 1 well	E-24	91	2	3	2	2		2.25	Temporary land disturbance during drilling of well. Less than 5 acres impacted.

* Strategy impact range: 1=positive; 2=no new; 3=minimal negative; 4=moderate negative; 5=significant negative

** Texas Parks & Wildlife Department's Natural Diversity Database of rare, threatened, and endangered species as of 12-21-2009.

*** All strategies occur beyond the distance of potential impact to flows into the coastal bay and estuary systems.

4.4 EL PASO WATER UTILITIES INTEGRATED STRATEGY

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*. 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 2011 Plan, the recommended Integrated Water Management Strategy in the 2006 *Far West Texas Water Plan* was updated as discussed below.

The non-agricultural demand in El Paso County is projected be 232,886 acre-feet per year by 2060. El Paso Water Utilities (EPWU) is projected to provide 207,702 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. These sources currently provide 131,000 acre-feet per year for EPWU. Non-agricultural demand in El Paso County not supplied by EPWU is projected to be about 25,000 acre-feet per year in 2060 and is supplied by groundwater from the Hueco Bolson, the Mesilla Bolson, and the Rio Grande Alluvium Aquifers.

The recommended strategy adopted to meet the needs for additional water supply for EPWU is composed of the following elements:

- Increased reclaimed water reuse (E-1)
- Increased conservation (E-2)
- Recharge of groundwater with treated surface water (E-3)
- Treatment of agricultural drain water (E-4)
- Increased use from the Rio Grande (developed conjunctively with local groundwater) (E-5)
- Importation of groundwater from the Bone Spring-Victorio Peak Aquifer in the Dell City area (Hudspeth County) (E-6)
- Importation of groundwater from the Capitan Reef Aquifer (Culberson and Hudspeth Counties) (E-7)

These strategies are discussed in the following 4.4 subsections.

Water supply generated from the combined El Paso Water Utilities Integrated Strategy provides water for not only the City of El Paso, but also for a number of other entities and industries in El Paso County. Strategies for these other entities are discussed in section 4.5.

4.4.1 REUSE (Strategy E-1)

A portion of the wastewater effluent from the Northwest, Haskell, Bustamante, and Fred Hervey Plants is currently being redirected into a water distribution system (Purple Pipeline) for users of the reclaimed water. Reclaimed water serves the demand of golf courses, parks, schools, steam electric power plants, and industries. Currently EPWU is operating three reuse projects that currently provide near 6,000 acre-feet per year. The recommended integrated strategy proposes to expand the reuse supply to 12,000 acre-feet per year by 2040. This expansion would require capital investment to modify or expand wastewater treatment plants and to expand the distribution of the Purple Pipeline.

The current water quality of the treated effluent makes a reuse project more feasible. The Fred Hervey WWTP is able to produce effluent that meets drinking water quality standards. It currently serves irrigation of ball fields, playgrounds and landscape. Although the effluent has high water quality, reuse for domestic supply may not be feasible due to concerns about the public acceptance of using reclaimed water to serve residential customers. Other WWTPs produce effluent with TDS levels above the drinking water quality standard, but the effluent is acceptable for uses such as irrigation of golf courses or parks. Reuse would have high reliability as water from direct reuse is available all year-round with acceptable quality.

4.4.2 CONSERVATION (Strategy E-2)

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 the last 13 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, and enforcement.

EPWU's water conservation efforts have reduced per capita municipal use in El Paso from 200 gallons per capita per day (gpcd) in the early 1970s to a current level of less than 140 gpcd. The overall per capita potable water use for EPWU and its wholesale customers, including steam electric and industrial use, was about 133 gpcd in 2008. 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. Table 4-5 shows the additional supplies that would result from the projected level of conservation. This appears to represent less conservation than in the 2006 Plan. That is because much of the conservation shown in the 2006 Plan has already been achieved and is reflected in the lower demand projections for this Plan. In fact, the level of conservation shown here reflects much lower per capita use for EPWU and its customers than in the 2006 Plan.

Table 4-5. Projected New Supplies Available To El Paso Water Utiltiies From Conservation

	2010	2020	2030	2040	2050	2060
Projected Population Served by El Paso Water Utilities	743,437	894,600	1,015,397	1,119,435	1,223,798	1,328,876
Projected Reduction in per Capita Use from 2010 Levels (gpcd)	0	3	6	9	12	15
Projected Conservation Supply in Acre-Feet	**0**	**3,000**	**7,000**	**11,000**	**16,000**	**22,000**

4.4.3 NEEDS AND STRATEGY FOR ADDITIONAL SUPPLY

Table 4-6 shows the resulting projected new water supply needs for EPWU after factoring out conservation and reuse. These new needs will be met with the implementation of the integrated strategy.

Table 4-6. Projected Needs for New Supplies for EPWU After Conservation and Reclaimed Water Reuse

	2010	2020	2030	2040	2050	2060
Projected demands on EPWU	118,167	145,445	162,190	176,770	191,728	207,702
Current supplies - EPWU	131,000	131,000	131,000	131,000	131,000	131,000
Total needs for new supplies	**0**	**14,445**	**31,190**	**45,770**	**60,728**	**76,702**
Conservation and Reclaimed Water						
Additional reclaimed water	0	2,000	4,000	6,000	6,000	6,000
Conservation	0	3,000	7,000	11,000	16,000	22,000
Total conservation and new reclaimed water	0	5,000	11,000	17,000	22,000	28,000
Needs for new supplies after conservation and reuse	**0**	**9,445**	**20,190**	**28,770**	**38,728**	**48,702**

It can be seen that the total needs for new supply for EPWU beyond conservation and reuse are slightly less than 50,000 acre-feet per year by 2060. The recommended integrated strategy includes development of the following sources of supply to meet these needs:

- Recharging the Hueco Bolson with treated surface water – 5,000 acre-feet per year
- Desalinating agricultural drain water – 2,700 acre-feet per year
- Increasing conjunctive use of water from the Rio Grande when available, supplemented by groundwater during droughts - 20,000 acre-feet per year
- Importation of groundwater from the Capitan Reef Aquifer – 10,000 acre-feet per year
- Importation of groundwater from the Dell City Area – 20,000 acre-feet per year

This recommended integrated strategy achieves a sustainable use of groundwater sources. For purposes of this Plan, the term "sustainable" refers to the predetermined maximum rate of withdrawal, based on existing data, that would likely make the source be economically available at least during the planning horizon and that would not produce significant water quality deterioration.

The strategy uses water from the Rio Grande and the Hueco and Mesilla Bolson Aquifers at a level considered sustainable from the groundwater management standpoint. Pumping from the Capitan Reef Aquifer is maintained in the lower end of the recharge range, which would secure continuous availability into the future without water quality deterioration. Groundwater imported from the Dell City area would be at a sustainable rate as permitted by the Hudspeth County Underground Water Conservation District #1. The integrated strategy is summarized in Table 4-7 and Figure 4-2. The elements of the strategy are discussed below.

Table 4-7. Development Of New Sources For EPWU

	2010	2020	2030	2040	2050	2060
Proposed Management Strategies for EPWU						
Additional conservation		3,000	7,000	11,000	16,000	22,000
Additional reclaimed water supply		2,000	4,000	6,000	6,000	6,000
Recharge of groundwater with treated surface water		5,000	5,000	5,000	5,000	5,000
Desalination of agricultural drain water		2,700	2,700	2,700	2,700	2,700
Additional conjunctive use		5,000	15,000	20,000	20,000	20,000
Groundwater from Capitan Reef				10,000	10,000	10,000
Groundwater from Dell City area					10,000	20,000
Total Proposed New Supply for EPWU	**0**	**17,700**	**33,700**	**54,700**	**69,700**	**85,700**

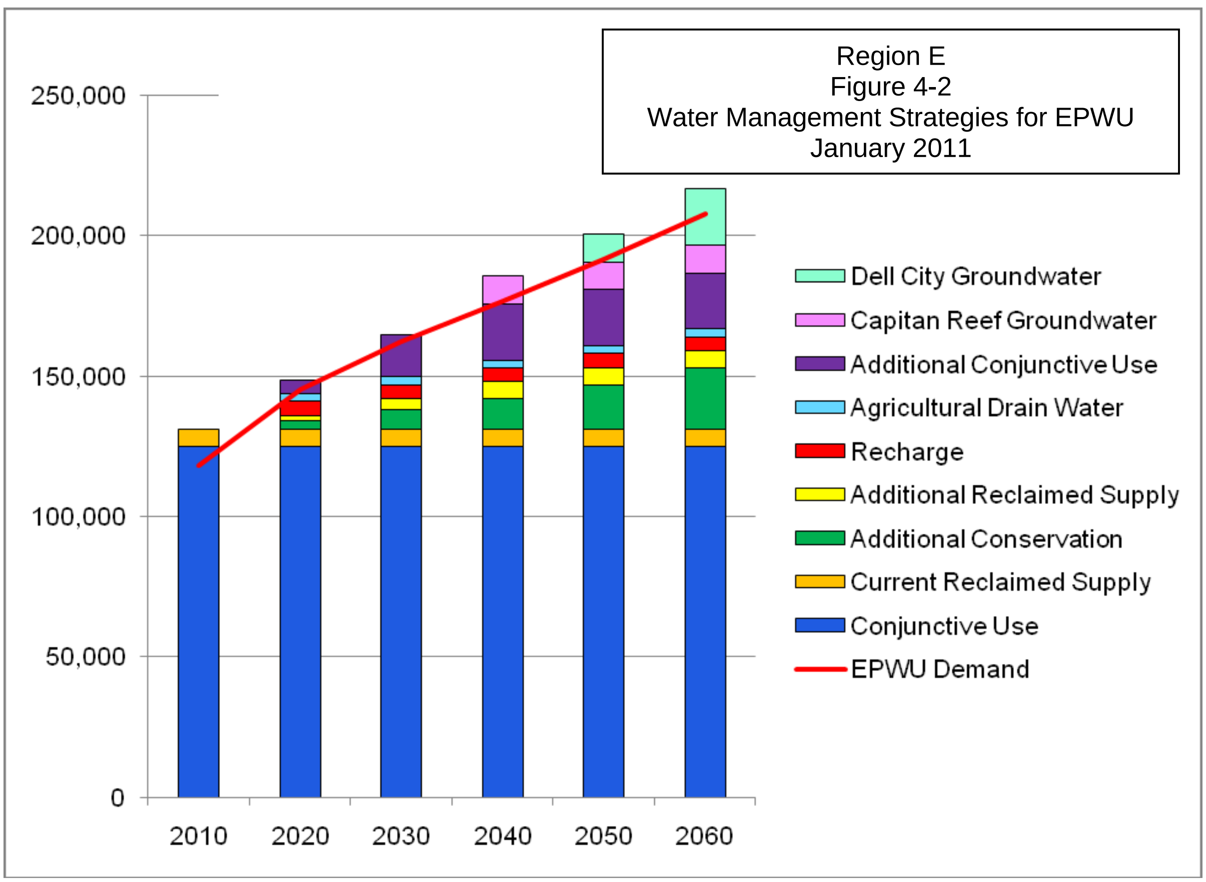

Figure 4-2. Water Management Strategies for EPWU

4.4.4 CONJUNCTIVE USE OF RIO GRANDE AND LOCAL GROUNDWATER

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 that allow the conversion of water allocated for irrigation of lands owned or leased by EPWU into municipal supply. Over time, EPWU may increase the annual diversion from surface water by converting additional water allocated to irrigated lands in El Paso County. Within the restriction of the various contracts, EPWU may lease irrigated lands in tracts inside EPCWID#1 boundary within the Rio Grande Project and use the water for municipal supply. The conversion of water for municipal supply requires contracts or agreements with the U.S. Bureau of Reclamation and EPCWID#1.

The allotment for irrigated lands is expressed in acre-feet of water per acre of land, which is calculated based upon the amount of water in Elephant Butte and Caballo reservoirs and determined by the U.S. Bureau of Reclamation to be allocation. The historical allotments have fluctuated between 0.33 and 4.0 acre-feet per acre of irrigable land. Surface water availability is variable from year to year. EPWU currently has contracts providing for an annual allotment of approximately 70,000 acre-feet per year in a full allotment year. Due to treatment capacity limitations and the pattern of demands, EPWU can use about 60,000 acre-feet per year in a full allotment year. Analysis with historical hydrologic data from 1940 to 2003 show that 60,000 acre-feet per year would be available for EPWU in 39 percent of the years and that less than 20,000 acre-feet per year would be available in 8 percent of the years. Therefore, surface water is not a reliable stand-alone source.

As a result, and as is the current practice, groundwater pumping in the Hueco and Mesilla would have to increase to replace surface water during droughts and in the winter. Therefore, as part of any strategy that considers an increased use of water from the Rio Grande, it is necessary to build additional surface water treatment capacity (or increase surface water use in wet years by some other method) and also to construct additional wells to produce sufficient groundwater in drought years.

The current supply from the conjunctive use of local groundwater and surface water is considered sustainable. However, a significant increase in groundwater pumping is likely to result in an unsustainable groundwater management (i.e. declining groundwater levels and declining groundwater storage). Large increases in pumping of the Hueco and Mesilla Bolsons would undoubtedly require desalination due to the large volumes of brackish groundwater in both the Hueco and Mesilla. It is estimated that the changes proposed in the recommended integrated water management strategy will not cause any significant water quality deterioration of groundwater, and the management of the aquifers will still be sustainable. The specific strategies to increase the conjunctive use of the Rio Grande and local surface water are as follows:

Recharge of Groundwater with Treated Surface Water (Strategy E-3): This strategy has been added since the *2006 Far West Texas Water Plan* was developed. The use of surface water by El Paso Water Utilities is currently limited by the water treatment plant capacity and the demand for water. 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 is planning to develop some recharge basins to recharge groundwater with treated surface water. This would make up to 5,000 acre-feet of treated surface water recharge per year available during years of full or near-full water availability, with lesser amounts of supply when surface water allotments are reduced. Retrieved supplies could be increased 5,000 acre-feet per year consisting of an average recharge surface water supply of about 3,000 acre-feet per year and an average groundwater supply of about 2,000 acre-feet per year.

Treatment of Agricultural Drain Water (Strategy E-4): This strategy has been added since the *2006 Far West Texas Water Plan* was developed. El Paso Water Utilities plans to develop 5 mgd desalination plants at the Rogers and Canal water treatment plants. These plants would treat agricultural drain water at the end of the irrigation season, when the level of dissolved salts becomes too high for conventional treatment. Since the drains generally flow for about 90 days after the water becomes too salty for conventional treatment, the 10 mgd of treatment capacity would provide 2,700 acre-feet per year of additional supply.

<u>Additional Conjunctive Use (Strategy E-5):</u> Additional conjunctive use of 5,000 acre-feet pear year is planned by 2020, increasing to 15,000 acre-feet per year by 2030 and 20,000 by 2040. In the 2006 Plan, an additional 20,000 acre-feet per year of conjunctive use was planned by 2020. The average additional surface water supply for an additional conjunctive use of 20,000 acre-feet per year would be 16,400 acre-feet per year. The average additional groundwater use would be 3,300 acre-feet per year from the Hueco Bolson and 300 acre-feet per year from the Mesilla Bolson. Implementing this strategy will require acquiring additional water rights for surface water and increasing EPWU's water treatment plant capacity. The higher demands that are projected over time will make it possible to make use of additional surface water supplies.

4.4.5 BONE SPRING-VICTORIO PEAK AQUIFER - DELL CITY AREA (Strategy E-6)

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) regulates groundwater pumping in this area. The key elements of the HCUWCD management plan and rules are the explicit management of groundwater on a sustainable basis, and the use of a historic period to grant permits to users. The long-term average recharge to the aquifer is estimated as 63,000 acre-feet per year in the management plan.

The rules of the District outline a permitting system that will result in limitations that are designed to achieve the sustainable pumping goals of the management plan. 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.
- 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 either a Validation Permit or 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. The amount of water available for operating permit allocations is determine on a pro-rata basis by the District's Board of Directors and must be based on the "degree to which the Average Water Level Elevation is greater than 3580.0 feet".

Transfer of water is limited to the consumptive use portion of the validation or operating permit. Under the current rules, the consumptive use under a full allocation (4.0 acre-feet/acre) is 2.8 acre-feet/acre. If the water allocation were reduced to 3.0 acre-feet/acre, consumptive use would be 2.1 acre-feet/acre. Therefore, to transfer the 20,000 acre-feet per year proposed under the preferred strategy, about 6,700 acres of land with validation permits would be needed under a full allocation scenario, and about 9,500 acres of land with validation permits would be required under a reduced allocation. The District has voided all Transfer permits pending the adoption of new rules regarding the export of water.

Concentrations of iron, chloride, nitrate, sulfate, and aluminum exceed water quality standards for municipal supply. Total dissolved solids in the area range from 1,810 to 3,900 mg/l. Desalination would be required before distribution for municipal use. Proposed importation from Dell City would begin in 2050 (10,000 acre-feet per year) and rise to 20,000 acre-feet per year in 2060.

4.4.6 CAPITAN REEF AQUIFER - DIABLO FARMS (Strategy E-7)

The Capitan Reef Aquifer is recognized as a minor aquifer by the TWDB. The majority of the aquifer is located in Culberson, Hudspeth, Jeff Davis, Pecos, Reeves, Ward, and Winkler Counties. In 2003 and 2004, EPWU purchased about 28,000 acres of land (Diablo Farms) overlying the Capitan Reef Aquifer straddling the Hudspeth and Culberson County lines in an area 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, although all the operating wells on Diablo Farms (one of the properties recently acquired by EPWU) have TDS values below 1,000 mg/L. However, it is expected that significant increases in historical 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 require no 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. 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 is proposed by 2040.

4.4.7 ENVIRONMENTAL IMPACTS

Conjunctive Use of Rio Grande and Local Groundwater

Additional use from the Rio Grande would have no major environmental impact on streamflow regime or flow frequencies, as water is available through a conversion of exiting diversion. Additional local groundwater use from the Hueco and Mesilla Bolson Aquifers would use existing infrastructure where possible and minimize new environmental impacts. New groundwater wells are proposed to replace existing wells with declining production and to provide additional capacity.

Bone Spring-Victorio Peak Aquifer (Dell City Area)

As with the Capitan Reef Aquifer above, the drilling of new wells and trenching of pipeline routes will disturb a small percentage of the land surface, thus causing a minor amount of environmental impact. A pipeline route connecting the source back to El Paso is expected to impact approximately 460 acres of right-of-way. The pipeline may be routed to avoid environmentally sensitive areas. 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.

A greater level of impact may be associated with the disposal of concentrate water resulting from the desalination process. Alternatives for disposal of desalination concentrate include deep well injection and the use of evaporation beds. Injection wells if constructed properly have minimal impact other than construction disturbances.

Capitan Reef Aquifer

The drilling of new wells and trenching of pipeline routes will disturb a small percentage of the land surface, thus causing a minor amount of environmental impact. The pipeline may be routed to avoid environmentally sensitive areas. The conversion of cultivated land associated with the well field to native rangeland may benefit some species, however; the loss of a food source (grain crops, etc.) may be detrimental to other species.

4.4.8 IMPACT TO RURAL AND AGRICULTURAL ACTIVITIES

Conjunctive Use of Rio Grande and Local Groundwater

Additional 20,000 acre-feet per year from the Rio Grande would be obtained after the retirement of about 5,000 acres of land from irrigation. This represents a reduction of agricultural activities in El Paso County. Two factors drive this conversion: expected population growth in El Paso County and economics. As more people live in El Paso County, some cropland necessarily will be converted to urban use. In addition, as population grows the cropland adjacent to urbanized area will become more valuable than the crops produced on the land or the rights of the Rio Grande Project water associated with the land. At that point, many agricultural producers will make the decision to convert their property to residential, commercial or some purpose other than irrigated agriculture. This conversion is primarily the result of urbanization, not the implementation of this water management strategy. Conversion would be voluntary by lease, sale, or forbearance agreements.

Bone Spring-Victorio Peak Aquifer (Dell City Area)

The integrated strategy would utilize the water rights for 9,500 acres of land in Hudspeth County, which would reduce irrigation activities near Dell City. The transfer to El Paso County is less than 1/3 of the maximum groundwater pumping limit. Conversion of water rights to transfer water to El Paso County would be voluntary. Some land may become unsuitable for agriculture after extensive irrigation with brackish water due to accumulation of salt in the soil, and would be retired from irrigation regardless of how much water is exported to El Paso County. It is expected that irrigators will find it economically beneficial to transfer or sell their land or water rights.

Capitan Reef Aquifer

EPWU owns land 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.

4.4.9 IMPACT ON NATURAL RESOURCES

Conjunctive Use of Rio Grande and Local Groundwater

There would be a gradual increase of pumping of the Hueco and Mesilla Bolson Aquifers, reaching a maximum level by 2060. Some deterioration in water quality is possible, but water could be used without desalination. The proposed level of pumping would continue to be considered nearly sustainable.

Dell City Area

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.

Capitan Reef

A pumping rate of 10,000 acre-feet per year is at the lower end of the range of estimated annual recharge to the Capitan Reef Aquifer, and therefore the aquifer water level will be maintained at a sustainable level without the occurrence of aquifer mining. Little or no water quality deterioration is anticipated.

4.4.10 INTEGRATED STRATEGY COST

Conservation

The cost for the conservation program is expected to be $1,000,000 per year, which is the cost experienced by EPWU in recent years. The conservation savings shown in Table 4-2 are based on a continuation of current EPWU programs and policies.

Reuse

Estimated capital cost of the reclaimed water is $25,270,000, with unit cost per acre-foot ranging from $334 to $538. By 2040, the amount of new reuse supply would be 6,000 acre-feet per year at a cost of $538 per acre-foot. Capital and annual cost of reuse by decade is shown in Table 4-8.

Table 4-8. Capital Cost Of The Reuse Strategy

Year	Capital Investment Items	New Reuse Capacity (ac-ft/yr)	Capital Cost	Total Debt Service	O&M	Total Annual Costs	$/ac-ft
2017	Expand Purple Pipeline.	2,000	$8,419,000	$ 612,000	$ 463,333	$ 1,075,333	$ 538
2027	WWTP Improvements. Expand Purple Pipeline. Avg. 4 mgd	4,000	$ 8,419,000	$ 1,224,000	$ 926,333	$ 2,150,333	$ 538
2037	Expand Purple Pipeline. Avg. 4 mgd	6,000	$ 8,419,000	$ 1,836,000	$ 1,389,000	$ 3,225,333	$538
			$ 25,257,000				

Other Sources of the Integrated Strategy

The capital cost of the other sources of the integrated strategy is $631,357,000. The cost for each phase is shown in Table 4-9. The unit costs for this strategy range from $508 to $1,241 per acre-foot, averaging $835. The discounted present value cost through 2060 is $656,792,000.

Table 4-9. Capital Cost Of The Preferred Integrated Strategy

Year	Capital Investment Item(s)	Supply	Capital Cost	Debt Service	New O&M	Annual Costs	$/AF
2016	Groundwater Recharge of Treated Surface Water	5,000	$ 14,625,000	$ 1,062,000	$ 1,648,000	$ 2,710,000	$ 547
2019	Desalination of Agricultural Drain Water	2,700	$ 16,875,000	$ 1,226,000	$ 1,286,000	$ 2,512,000	$ 930
2020	New conjunctive surface water and groundwater*	5,000	$ 84,229,000	$ 6,119,000	$ 2,234,000	$ 8,353,000	$ 1,671*
2023	New conjunctive surface water and groundwater	10,000	$ 22,042,000	$ 1,601,000	$ 4,160,000	$ 5,761,000	$ 576
2033	New conjunctive surface water and groundwater	5,000	$ 33,967,000	$ 2,468,000	$ 1,628,000	$ 4,096,000	$ 819
2040	El Capitan Reef – 10,000 af/yr*	10,000	$ 245,506,000	$ 17,836,000	$ 5,694,000	$ 23,530,000	$ 2,353*
2050	Dell City Groundwater*	10,000	$ 135,143,000	$ 9,818,000	$ 5,473,000	$ 15,291,000	$ 1,529*
2060	Additional Dell City Groundwater	10,000	$78,970,000	$ 5,737,000	$ 5,149,000	$ 10,886,000	$ 1,089
	TOTAL		**$ 631,357,000**		**$ 27,272,000**		

* Note – These items include extra capacity in parts of the system that will be used by later items, which make their unit costs appear high.

4.4.11 WATER SOURCE RELIABILITY

Under the concept of conjunctive use, pumping from the Hueco and Mesilla Bolsons is increased to supplement the surface water that is not available during lower flows. As a result, groundwater use also fluctuates. The integrated strategy proposes an increased conjunctive use. However, the long-term average pumping will not cause significant depletions of the groundwater sources or significant deterioration of groundwater quality in the long term. At the recommended conjunctive use level of this strategy, the Hueco and Mesilla Bolsons will be available when needed to supplement surface water. It is expected that other sources (Capitan Reef and Bone Spring-Victorio Peak Aquifers) will be available throughout the planning horizon with little change in water quality. Therefore, the overall reliability of the integrated strategy is very high.

4.5 EL PASO COUNTY STRATEGIES FOR ENTITIES SUPPLIED BY EPWU

Water supply to meet deficits projected for the following entities will be provided from the combined (blended) EPWU sources developed in the previously described EPWU Integrated Strategy. Cost, conservation, reliability, and impacts to environmental, natural resources, and third party interests are thus covered in Section 4.4.

Entities serviced by the Lower Valley Water District, which receives its supply from EPWU:

- El Paso County Other (E-10)
- San Elizario (E-11)
- Socorro (E-12)

Entities served totally or partly by EPWU:

- Fort Bliss (E-9)
- Vinton (E-14)
- El Paso County Other (E-15)
- Manufacturing (E-16)
- Steam Electric Power (E-17)

4.6 EL PASO COUNTY MUNICIPAL STRATEGIES FOR ENTITIES NOT SUPPLIED BY EPWU

4.6.1 Horizon Regional MUD

Horizon Regional MUD provides water for the greater Horizon community.

Conservation - Due to Horizon's water use per capita being significantly lower than the state average, no conservation strategy was considered necessary.

Additional Wells and Desalination (Strategy E-8)

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 some wells in the Hueco Bolson that do not require desalination. Table 4-1 shows that Horizon Regional MUD will require additional infrastructure to produce the needed supply in the decade beginning in the year 2020. The recommended strategies include expanding the desalination plant, building a second desalination plant, and acquiring additional wells in the Rio Grande Alluvium.

Cost: As shown in Table 4-2, the capital cost of the strategies suggested for Horizon Regional MUD is $34,344,000 between now and 2060.

Quality and Reliability: 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 aquifer; therefore, the source is considered reliable.

Impacts: Temporary land disturbance will occur during the construction of a new desalination plant, the drilling of the wells and the trenching of additional pipeline routes. This will result in temporary minor environmental impacts during the construction period. There are no anticipated new impacts to water, agriculture or natural resources.

4.6.2 El Paso County Tornillo WID

El Paso County Tornillo WID provides water for the Community of Tornillo and surrounding neighborhoods.

Conservation - Due to Tornillo's water use per capita being significantly lower than the state average, no conservation strategy was considered necessary.

New Wells (Strategy E-13)

The District has received funding from El Paso County to construct a new well, which is expected to be 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 described in the following Strategy E-23.

Cost: Total capital cost for the initial public supply well is $503,381 with an annual operations and maintenance cost of $5,000. These costs will double to $1,006,762 and $10,000 respectively when the second well comes on line in 2040.

Quality and Reliability: The groundwater source will continue to be slightly brackish and may potentially deteriorate in quality slightly over time. There is a significant quantity of slightly brackish quality water in the aquifer in the vicinity of the Districts wells; therefore, the source is considered reliable.

Impacts: Temporary land disturbance will occur during the drilling of a well and the trenching of additional pipeline routes. This will result in temporary minor environmental impacts during the construction period. There are no anticipated new impacts to water, agriculture or natural resources.

Arsenic Treatment Facility (Strategy E-23)

The township of Tornillo is unincorporated community in El Paso County with a current population of approximately 3,400 people and has been designated as a "Colonia". The El Paso County Tornillo Water Improvement District (TWID) provides water services to approximately 912, mostly residential, connections within the community. In 2005, the

TWID received an alert from TCEQ for future arsenic exceedence. The TWID 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 water from existing wells to provide acceptable water to Tornillo residents.

The facility will 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 (*El Paso Tornillo Water Improvement District Arsenic Treatment Facility Engineering Report; Prepared for TCEQ by Brown and Caldwell; August 6, 2009*). 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.

<u>Cost:</u> Total capital cost of the project is estimated at $1,996,232, with annual operations and maintenance costs of $9,413. Annual cost per acre-foot is $34.

<u>Quality and Reliability:</u> TWID's water supply source is the Hueco Bolson Aquifer. 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.

<u>Impacts:</u> Although a recent Environmental Assessment of the area has not yet been conducted, it is anticipated that impacts associated with the construction of a new arsenic treatment facility should be limited. The facility will be constructed entirely within the confines of TWID's existing well site location on TWID property. New ground will not be disturbed for this project. The TWID 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 community of Tornillo, thus the potential water level decline would be relatively localized.

4.7 CITY OF MARFA

One New Well (Strategy E-24)

The City of Marfa currently has two water wells (Wells #2 and #3) that supply water to the City. These wells are all located on the same site. TCEQ has raised concern over the proximity of these wells to each other since any change in the aquifer recharge, contamination of the site or other catastrophe that may impact the site will likely impact all water supply wells drilled in the area. In addition to the proximity issues, the well equipment in Well No.3 is very old and attempts to service the well pump have been unsuccessful due to the inability to remove the pump from the well casing. If any of the subsurface parts of this well fail, the City's water supply capability will be reduced by one half with no real backup, and the City will not be able to meet municipal demand. It is for these reasons that the City is pursuing funding for drilling a new well in a location away from the existing water plant.

Cost: Total capital cost for the public supply well is $702,770, which includes $402,770 for the well, $150,000 for 5,000 feet of pipeline (plus boring under State Highway), plus land acquisition costs. Annual operations and maintenance cost is anticipated to be $5,000.

Quality and Reliability: The groundwater source (Davis Mountains Igneous Aquifer) will continue to be fresh; however, as with the City's other wells, fluoride tends to be elevated. After obtaining a replacement well, the City will pursue a treatment facility to mitigate the fluoride issue. There is sufficient groundwater in the local aquifer system to allow this well to be pumped on a sustainable basis.

Impacts: Temporary land disturbance will occur during the drilling of a well and the trenching of additional pipeline routes to connect with existing distribution system. This will result in temporary minor environmental impacts during the construction period. There are no anticipated new impacts to water, agriculture or natural resources since this project is intended to sustain existing needs and not spur new development or growth.

4.8 IRRIGATION STRATEGIES

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. The Texas Water Development Board (TWDB), through the Water Conservation Implementation Task Force has published a report titled Water Conservation Best Management Practices Guide (TWDB Report 362), which in part contains numerous BMPs for agricultural water users.

During the current 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. A summary of this report titled " Evaluation of Irrigation Efficiency Strategies for Far West Texas: Feasibility, Water Savings and Cost Considerations" is provided in Appendix 1A of Chapter 1. The entire report can be viewed at http://www.riocog.org/EnvSvcs/FWTWPG/InterimStudies/Irrigation Efficiency Report-June-21-09-TWDB-ed.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 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.

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 and Hudspeth Counties. The strategies are intended for irrigation practices within the El Paso County Water Improvement District#1, the Hudspeth County Conservation and Reclamation District#1, and the Hudspeth County Underground Water Conservation District#1. The potential water savings for the three districts under both drought and full supply conditions is shown in Table 4-10.

Table 4-10. Potential Water Savings for Three Districts

(Acre-feet per year)

BMP Strategy	EPCWID #1		HCCRD #1		HCUWCD #1	
	Drought	Full	Drought	Full	Drought	Full
Scheduling (subtotal)	1,740	5,070	0	1,275	3,535	11,179
Pivot/Sprinkler	-	-	-	-	2,357	7,453
Surface Irrigation	-	-	-	-	1,178	3,726
Pipeline/Lining District Canals	25,000	50,000	-	-	NA	NA
Tailwater Reuse	1,723	6,274	0	1,275	589	1,863
Total	**28,463**	**61,344**	**0**	**2,550**	**4,124**	**13,032**

Irrigation scheduling 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. 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.

Tailwater Recovery and Reuse Systems are 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). Reservoirs or pump 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.

Improvements to Water District Delivery Systems:

Lining of District Irrigation Canals involves the installation of a fixed lining impervious material in an existing or newly constructed canal. Three commonly used liners include Ethylene-Propylene-Diene Monomer (EPDM), urethane, and concrete. 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.

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.

4.8.1 Strategies for El Paso County Water Improvement District #1

Three strategies are found to have viable water savings potential for producers and the EPCWID #1. The potential water savings for the district under both drought and full supply conditions is shown in Table 4-11. Irrigation Scheduling is estimated to have a 5-10 percent rate of water savings, during non-drought years, for water delivered to the farm for those producers currently not using some form of irrigation scheduling. Estimated annual costs range between $24 and $55 per acre-foot with annual water savings between 1,700 and 5,000 acre-feet.

Estimated annual costs for installation of tailwater reuse systems range between $185 and $529 per acre-foot with water savings between 1,700 and 6,300 acre-feet. Water savings from lining District canals and laterals, as well as the Replacement of District Canals with Pipelines, was estimated at a reduction of 80 percent of seepage losses.

The average annual cost for a pipeline is estimated at $170 to $339 per acre-foot (and 10 percent higher for lining of canals), higher than the value in irrigated agriculture. When adding in the value for avoided pumping costs and municipal value, it is a cost-effective BMP. It should be noted that implementation of a large-scale canal lining project will reduce or eliminate a large component of recharge to the underlying aquifer system. The District is currently evaluating the expansion of canal lining and pipeline implementation. Therefore if implemented, this could affect groundwater availability and water supply strategies that rely upon these groundwater resources and these would need to be reevaluated in future regional water plans.

Several suggested strategies have already been completed in the area and the potential for water savings have already been realized. These strategies include the Volumetric Measurement of Irrigation Water, Land Leveling, Lining of On-Farm Irrigation Ditches, and Automation and Telemetry. All pressurized systems were considered inapplicable to the study area due to water quality, the predominate use of surface water, gravity flow irrigation methods, and the water delivery system.

Table 4-11. Water Savings and Cost Estimates for EPCWID #1

BMP Strategy	Water Savings (af)		Annual Cost ($)		Unit Cost ($/af)	
	Drought	Full	Drought	Full	Drought	Full
Scheduling	1,740	5,070	96,000	122,400	55.17	24.14
Pipelines for District Canals*	25,000	50,000	8,487,434	8,487,434	339	170
Tailwater Reuse	1,723	6,274	910,800	1,161,270	529	185

* Present value of annual cost including capital cost and annual operating and maintenance (discount rate of 5.5% over 30 years life expectancy), using 206 miles of canals

4.8.2 Strategies for Hudspeth County Conservation and Reclamation District #1

Results for the analysis of HCCRD #1 are similar to the results from EPCWID #1; however, since water availability is dependent on return flows from the EPCWID #1, water savings are more difficult to quantify. Irrigation Scheduling and Tailwater Reuse are found to have potential for future water savings. The potential water savings for the district under both drought and full supply conditions is shown in Table 4-12. Maximum annual water savings range between 0 and 1,300 acre-feet with annual costs between $63 and $364 per acre-foot.

Strategies that have already been completed in the HCCRD #1, thus resulting in no new water savings, include the Volumetric Measurement of Irrigation Water, Land Leveling, Lining of On-Farm Irrigation Ditches, and Automation and Telemetry. All pressurized systems were considered inapplicable to the study area due to water quality, the predominate use of surface water, gravity flow irrigation methods, and the water delivery system.

Table 4-12. Water Savings and Cost Estimates for HCCRD #1

BMP Strategy	Water Savings (af)		Annual Cost ($)		Unit Cost ($/af)	
	Drought	Full	Drought	Full	Drought	Full
Scheduling	0	1,275	38,400	80,700	NA	63.29
Tailwater Reuse	0	1,275	220,800	464,025	NA	364

4.8.3 Strategies for Hudspeth County Underground Water Conservation District #1

Results from analyzing the groundwater district in this study revealed that there are potential opportunities for water savings from Irrigation Scheduling, the expanded use of Linear Move Sprinkler Irrigation Systems, and improvements to current Tailwater Recover and Reuse Systems. The potential water savings for the district under both drought and full supply conditions is shown in Table 4-13. Estimated savings from Irrigation Scheduling is between 7 percent and 15 percent of water pumped with costs ranging between $18 and $83 per acre-foot. Additional savings are possible from reduced pumping costs. By improving current tailwater recovery and reuse systems, between 10-15 percent water savings are expected with costs ranging between $104 and $329 per acre-foot.

Suggested strategies that have already been implemented in the Dell City area and therefore have already realized potential water savings include the 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, the use of Gated/Flexible Pipe for field water distribution, and the regulating of the aquifer.

Table 4-13. Water Savings and Cost Estimates for HCUWCD #1

BMP Strategy	Water Savings (af)		Annual Cost ($)		Unit Cost ($/af)	
	Drought	Full	Drought	Full	Drought	Full
Scheduling						
Pivot/Sprinkler	2,357	7,453	202,920	202,920	83	27
Surface Irrigation	1,178	3,726	67,650	37,650	57	18
Tailwater Reuse						
Surface Irrigation	589	1,863	194,063	194,063	329	104

4.8.4 Quality and Reliability

All irrigation strategies more conservatively utilize water supplies that, from a water quality perspective, are acceptable for agricultural use. Pumping limitations imposed by the HCUWCD#1 are intended to maintain withdrawals from the aquifer at a sustainable level, while Rio Grande supply use by the two surface water districts is interruptible during droughts.

4.8.5 Impacts

The implementation of the irrigation strategies generally results in no change to existing environmental conditions. However, minor temporary land disturbance will occur as pipelines are buried and open canals are lined. The irrigations strategies should have a positive impact on existing water resources and no new impacts to agricultural and natural resources.

4.9 DESALINATION POTENTIAL

The potential for desalination of brackish water in Far West Texas is not only feasible, but is currently in operation. For desalination to be a viable alternative, a number of issues should be addressed:

- Is there a supply need
- Is the source of sufficient quantity to last the life of the plant
- Is the chemical quality of the source within a reasonable range to make desalination effective
- Is the source within an economical distance from the area of need
- Is there a satisfactory means of disposing of the process concentrate
- Is the desalination process economically comparable to other alternatives

Many of the aquifers in Far West Texas contain significant quantities of brackish groundwater containing dissolved-solids concentrations of between 1,000 and 10,000 milligrams per liter (mg/L). The process of desalination of brackish quality sources or the simple blending of brackish and fresh sources makes these resources available for municipal drinking-water use. The community of Dell City and the Horizon Regional MUD operate desalination plants to reduce the concentration of TDS in groundwater produced from the Bone Spring-Victorio Peak, Hueco Bolson, and Rio Grande Alluvium Aquifers. The City of El Paso blends fresh water with marginally elevated TDS water. Also, 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. These types of facilities allow the use of water previously unusable from a public water supply perspective. Also, by using brackish supplies to meet a portion of the total water demand, fresh groundwater sources are maintained for longer periods of time.

A supply component of the *integrated water management strategy* discussed in Section 4.4 of this chapter is the Bone Spring-Victorio Peak Aquifer in Hudspeth Counties.

The implementation of the use of this supply will require desalination as the aquifer contains dissolved-solids concentrations of 1,800 to 3,900 mg/L.

As discussed in Chapter 5 and illustrated in Figure 5-1, brackish groundwater exists throughout much of the Region. Besides the Bone Spring-Victorio Peak, other aquifer sources containing sufficient quantities of brackish groundwater capable of meeting desalination process needs include both the Hueco and Mesilla Bolsons in the El Paso and Hudspeth Counties, the Capitan Reef in Culberson County, Wild Horse Flat and Lobo Flat Aquifers in Culberson County, and the Rio Grande Alluvium in El Paso, Hudspeth, and Presidio Counties. Distance needed to transport the sources to areas where the supply is needed will likely prevent the development of some of these sources.

4.10 EMERGENCY TRANSFER CONSIDERATIONS

The Texas Legislature has established a statute (Texas Water Code 11.139) by which non-municipal surface-water rights may temporarily be interrupted to make water available for public-supply needs during times of emergencies. The intent of the statute is to reduce the health and safety impact to communities that have run short of water because of unexpected circumstances. The statute was specifically enacted as an emergency process to bring relief to several communities that had been affected by drought conditions that had severely diminished their water-supply sources. The FWTWPG considered the potential for emergency transfer of surface water for communities in the Region and chose not to recommend this strategy for this planning period.

APPENDIX 4A

SOCIOECONOMIC IMPACTS OF UNMET WATER NEEDS

Socioeconomic Impacts of Projected Water Shortages for the Far West Texas (Region E) Regional Water Planning Area

Prepared in Support of the 2011 Far West Texas Regional Water Plan

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Introduction

Water shortages during drought would likely curtail or eliminate economic activity in business and industries reliant on water. For example, without water farmers cannot irrigate; refineries cannot produce gasoline, and paper mills cannot make paper. Unreliable water supplies would not only have an immediate and real impact on existing businesses and industry, but they could also adversely affect economic development in Texas. From a social perspective, water supply reliability is critical as well. Shortages would disrupt activity in homes, schools and government and could adversely affect public health and safety. For all of the above reasons, it is important to analyze and understand how restricted water supplies during drought could affect communities throughout the state.

Administrative rules require that regional water planning groups evaluate the impacts of not meeting water needs as part of the regional water planning process, and rules direct TWDB staff to provide technical assistance: "*The executive administrator shall provide available technical assistance to the regional water planning groups, upon request, on water supply and demand analysis, including methods to evaluate the social and economic impacts of not meeting needs*" [(§357.7 (4)(A)]. Staff of the TWDB's Water Resources Planning Division designed and conducted this report in support of the Far West Texas Regional Water Planning Group (Region E).

This document summarizes the results of our analysis and discusses the methodology used to generate the results. Section 1 outlines the overall methodology and discusses approaches and assumptions specific to each water use category (i.e., irrigation, livestock, mining, steam-electric, municipal and manufacturing). Section 2 presents the results for each category where shortages are reported at the regional planning area level and river basin level. Results for individual water user groups are not presented, but are available upon request.

1. Methodology

Section 1 provides a general overview of how economic and social impacts were measured. In addition, it summarizes important clarifications, assumptions and limitations of the study.

1.1 Economic Impacts of Water Shortages

1.1.1 General Approach

Economic analysis as it relates to water resources planning generally falls into two broad areas. Supply side analysis focuses on costs and alternatives of developing new water supplies or implementing programs that provide additional water from current supplies. Demand side analysis concentrates on impacts or benefits of providing water to people, businesses and the environment. Analysis in this report focuses strictly on demand side impacts. When analyzing the economic impacts of water shortages as defined in Texas water planning, three potential scenarios are possible:

1) Scenario 1 involves situations where there are physical shortages of raw surface or groundwater due to drought of record conditions. For example, City A relies on a reservoir with average conservation storage of 500 acre-feet per year and a firm yield of 100 acre feet. In 2010, the city uses about 50 acre-feet per year, but by 2030 their demands are expected to increase to 200 acre-feet. Thus, in 2030 the reservoir would not have enough water to meet the city's demands,

and people would experience a shortage of 100 acre-feet assuming drought of record conditions. Under normal or average climatic conditions, the reservoir would likely be able to provide reliable water supplies well beyond 2030.

2) Scenario 2 is a situation where despite drought of record conditions, water supply sources can meet existing use requirements; however, limitations in water infrastructure would preclude future water user groups from accessing these water supplies. For example, City B relies on a river that can provide 500 acre-feet per year during drought of record conditions and other constraints as dictated by planning assumptions. In 2010, the city is expected to use an estimated 100 acre-feet per year and by 2060 it would require no more than 400 acre-feet. But the intake and pipeline that currently transfers water from the river to the city's treatment plant has a capacity of only 200 acre-feet of water per year. Thus, the city's water supplies are adequate even under the most restrictive planning assumptions, but their conveyance system is too small. This implies that at some point – perhaps around 2030 - infrastructure limitations would constrain future population growth and any associated economic activity or impacts.

3) Scenario 3 involves water user groups that rely primarily on aquifers that are being depleted. In this scenario, projected and in some cases existing demands may be unsustainable as groundwater levels decline. Areas that rely on the Ogallala aquifer are a good example. In some communities in the region, irrigated agriculture forms a major base of the regional economy. With less irrigation water from the Ogallala, population and economic activity in the region could decline significantly assuming there are no offsetting developments.

Assessing the social and economic effects of each of the above scenarios requires various levels and methods of analysis and would generate substantially different results for a number of reasons; the most important of which has to do with the time frame of each scenario. Scenario 1 falls into the general category of static analysis. This means that models would measure impacts for a small interval of time such as a drought. Scenarios 2 and 3, on the other hand imply a dynamic analysis meaning that models are concerned with changes over a much longer time period.

Since administrative rules specify that planning analysis be evaluated under drought of record conditions (a static and random event), socioeconomic impact analysis developed by the TWDB for the state water plan is based on assumptions of Scenario 1. Estimated impacts under scenario 1 are point estimates for years in which needs are reported (2010, 2020, 2030, 2040, 2050 and 2060). They are independent and distinct "what if" scenarios for a particular year and shortages are assumed to be temporary events resulting from drought of record conditions. Estimated impacts measure what would happen if water user groups experience water shortages for a period of one year.

The TWDB recognize that dynamic models may be more appropriate for some water user groups; however, combining approaches on a statewide basis poses several problems. For one, it would require a complex array of analyses and models, and might require developing supply and demand forecasts under "normal" climatic conditions as opposed to drought of record conditions. Equally important is the notion that combining the approaches would produce inconsistent results across regions resulting in a so-called "apples to oranges" comparison.

A variety tools are available to estimate economic impacts, but by far, the most widely used today are input-output models (IO models) combined with social accounting matrices (SAMs). Referred to as IO/SAM models, these tools formed the basis for estimating economic impacts for agriculture (irrigation and livestock water uses) and industry (manufacturing, mining, steam-electric and commercial business activity for municipal water uses).

Since the planning horizon extends through 2060, economic variables in the baseline are adjusted in accordance with projected changes in demographic and economic activity. Growth rates for municipal water use sectors (i.e., commercial, residential and institutional) are based on TWDB population forecasts. Future values for manufacturing, agriculture, and mining and steam-electric activity are based on the same underlying economic forecasts used to estimate future water use for each category.

The following steps outline the overall process.

Step 1*: Generate IO/SAM Models and Develop Economic Baseline*

IO/SAM models were estimated using propriety software known as IMPLAN PRO™ (Impact for Planning Analysis). IMPLAN is a modeling system originally developed by the U.S. Forestry Service in the late 1970s. Today, the Minnesota IMPLAN Group (MIG Inc.) owns the copyright and distributes data and software. It is probably the most widely used economic impact model in existence. IMPLAN comes with databases containing the most recently available economic data from a variety of sources.[1] Using IMPLAN software and data, transaction tables conceptually similar to the one discussed previously were estimated for each county in the region and for the region as a whole. Each transaction table contains 528 economic sectors and allows one to estimate a variety of economic statistics including:

- **total sales -** total production measured by sales revenues;
- **intermediate sales -** sales to other businesses and industries within a given region;
- **final sales –** sales to end users in a region and exports out of a region**;**
- **employment -** number of full and part-time jobs (annual average) required by a given industry including self-employment;
- **regional income -** total payroll costs (wages and salaries plus benefits) paid by industries, corporate income, rental income and interest payments; and
- **business taxes -** sales, excise, fees, licenses and other taxes paid during normal operation of an industry (does not include income taxes).

TWDB analysts developed an economic baseline containing each of the above variables using year 2000 data. Since the planning horizon extends through 2060, economic variables in the baseline were allowed to change in accordance with projected changes in demographic and economic activity. Growth rates for municipal water use sectors (i.e., commercial, residential and institutional) are based on TWDB population forecasts. Projections for manufacturing, agriculture, and mining and steam-electric activity are based on the same underlying economic forecasts used to estimate future water use for each category. Monetary impacts in future years are reported in constant year 2006 dollars.

It is important to stress that employment, income and business taxes are the most useful variables when comparing the relative contribution of an economic sector to a regional economy. Total sales as reported in IO/SAM models are less desirable and can be misleading because they include sales to other industries in the region for use in the production of other goods. For example, if a mill buys grain from local farmers and uses it to produce feed, sales of both the processed feed and raw corn are counted as "output" in an IO model. Thus, total sales double-count or overstate the true economic value of goods

[1]The IMPLAN database consists of national level technology matrices based on benchmark input-output accounts generated by the U.S. Bureau of Economic Analysis and estimates of final demand, final payments, industry output and employment for various economic sectors. IMPLAN regional data (i.e. states, a counties or groups of counties within a state) are divided into two basic categories: 1) data on an industry basis including value-added, output and employment, and 2) data on a commodity basis including final demands and institutional sales. State-level data are balanced to national totals using a matrix ratio allocation system and county data are balanced to state totals.

and services produced in an economy. They are not consistent with commonly used measures of output such as Gross National Product (GNP), which counts only final sales.

Another important distinction relates to terminology. Throughout this report, the term *sector* refers to economic subdivisions used in the IMPLAN database and resultant input-output models (528 individual sectors based on Standard Industrial Classification Codes). In contrast, the phrase *water use category* refers to water user groups employed in state and regional water planning including irrigation, livestock, mining, municipal, manufacturing and steam electric. Each IMPLAN sector was assigned to a specific water use category.

Step 2: *Estimate Direct and Indirect Economic Impacts of Water Needs*

Direct impacts are reductions in output by sectors experiencing water shortages. For example, without adequate cooling and process water a refinery would have to curtail or cease operation, car washes may close, or farmers may not be able to irrigate and sales revenues fall. Indirect impacts involve changes in inter-industry transactions as supplying industries respond to decreased demands for their services, and how seemingly non-related businesses are affected by decreased incomes and spending due to direct impacts. For example, if a farmer ceases operations due to a lack of irrigation water, they would likely reduce expenditures on supplies such as fertilizer, labor and equipment, and businesses that provide these goods would suffer as well.

Direct impacts accrue to immediate businesses and industries that rely on water and without water industrial processes could suffer. However, output responses may vary depending upon the severity of shortages. A small shortage relative to total water use would likely have a minimal impact, but large shortages could be critical. For example, farmers facing small shortages might fallow marginally productive acreage to save water for more valuable crops. Livestock producers might employ emergency culling strategies, or they may consider hauling water by truck to fill stock tanks. In the case of manufacturing, a good example occurred in the summer of 1999 when Toyota Motor Manufacturing experienced water shortages at a facility near Georgetown, Kentucky.[2] As water levels in the Kentucky River fell to historic lows due to drought, plant managers sought ways to curtail water use such as reducing rinse operations to a bare minimum and recycling water by funneling it from paint shops to boilers. They even considered trucking in water at a cost of 10 times what they were paying. Fortunately, rains at the end of the summer restored river levels, and Toyota managed to implement cutbacks without affecting production, but it was a close call. If rains had not replenished the river, shortages could have severely reduced output.[3]

To account for uncertainty regarding the relative magnitude of impacts to farm and business operations, the following analysis employs the concept of elasticity. Elasticity is a number that shows how a change in one variable will affect another. In this case, it measures the relationship between a percentage reduction in water availability and a percentage reduction in output. For example, an elasticity of 1.0 indicates that a 1.0 percent reduction in water availability would result in a 1.0 percent reduction in economic output. An elasticity of 0.50 would indicate that for every 1.0 percent of unavailable water, output is reduced by 0.50 percent and so on. Output elasticities used in this study are:[4]

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[2] Royal, W. "*High And Dry - Industrial Centers Face Water Shortages*." in Industry Week, Sept, 2000.

[3] The efforts described above are not planned programmatic or long-term operational changes. They are emergency measures that individuals might pursue to alleviate what they consider a temporary condition. Thus, they are not characteristic of long-term management strategies designed to ensure more dependable water supplies such as capital investments in conservation technology or development of new water supplies.

[4] Elasticities are based on one of the few empirical studies that analyze potential relationships between economic output and water shortages in the United States. The study, conducted in California, showed that a significant number of industries would suffer reduced output during water shortages. Using a survey based approach researchers posed two scenarios to different industries. In

- if water needs are 0 to 5 percent of total water demand, no corresponding reduction in output is assumed;
- if water needs are 5 to 30 percent of total water demand, for each additional one percent of water need that is not met, there is a corresponding 0.50 percent reduction in output;
- if water needs are 30 to 50 percent of total water demand, for each additional one percent of water need that is not met, there is a corresponding 0.75 percent reduction in output; and
- if water needs are greater than 50 percent of total water demand, for each additional one percent of water need that is not met, there is a corresponding 1.0 percent (i.e., a proportional reduction).

In some cases, elasticities are adjusted depending upon conditions specific to a given water user group.

Once output responses to water shortages were estimated, direct impacts to total sales, employment, regional income and business taxes were derived using regional level economic multipliers estimating using IO/SAM models. The formula for a given IMPLAN sector is:

$$D_{i,t} = Q_{i,t} *_{,} S_{i,t} * E_Q * RFD_i * DM_{i(Q, L, I, T)}$$

where:

$D_{i,t}$ = direct economic impact to sector *i* in period *t*

$Q_{i,t}$ = total sales for sector *i* in period *t* in an affected county

$RFD_{i,}$ = ratio of final demand to total sales for sector *i* for a given region

$S_{i,t}$ = water shortage as percentage of total water use in period *t*

E_Q = elasticity of output and water use

$DM_{i(L, I, T)}$ = direct output multiplier coefficients for labor (L), income (I) and taxes (T) for sector *i*.

Secondary impacts were derived using the same formula used to estimate direct impacts; however, indirect multiplier coefficients are used. Methods and assumptions specific to each water use sector are discussed in Sections 1.1.2 through 1.1.4.

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the first scenario, they asked how a 15 percent cutback in water supply lasting one year would affect operations. In the second scenario, they asked how a 30 percent reduction lasting one year would affect plant operations. In the case of a 15 percent shortage, reported output elasticities ranged from 0.00 to 0.76 with an average value of 0.25. For a 30 percent shortage, elasticities ranged from 0.00 to 1.39 with average of 0.47. For further information, see, California Urban Water Agencies, "*Cost of Industrial Water Shortages,*" Spectrum Economics, Inc. November, 1991.

General Assumptions and Clarification of the Methodology

As with any attempt to measure and quantify human activities at a societal level, assumptions are necessary and every model has limitations. Assumptions are needed to maintain a level of generality and simplicity such that models can be applied on several geographic levels and across different economic sectors. In terms of the general approach used here several clarifications and cautions are warranted:

1. Shortages as reported by regional planning groups are the starting point for socioeconomic analyses.

2. Estimated impacts are point estimates for years in which needs are reported (i.e., 2010, 2020, 2030, 2040, 2050 and 2060).They 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 combined with infrastructure limitations. In other words, growth occurs and future shocks are imposed on an economy at 10-year intervals and resultant impacts are measured. Given, that reported figures are not cumulative in nature, it is inappropriate to sum impacts over the entire planning horizon. Doing so, would imply that the analysis predicts that drought of record conditions will occur every ten years in the future, which is not the case. Similarly, authors of this report recognize that in many communities needs are driven by population growth, and in the future total population will exceed the amount of water available due to infrastructure limitations, regardless of whether or not there is a drought. This implies that infrastructure limitations would constrain economic growth. However, since needs as defined by planning rules are based upon water supply and demand under the assumption of drought of record conditions, it improper to conduct economic analysis that focuses on growth related impacts over the planning horizon. Figures generated from such an analysis would presume a 50-year drought of record, which is unrealistic. Estimating lost economic activity related to constraints on population and commercial growth due to lack of water would require developing water supply and demand forecasts under "normal" or "most likely" future climatic conditions.

3. While useful for planning purposes, this study is not a benefit-cost analysis. Benefit cost analysis is a tool widely used to evaluate the economic feasibility of specific policies or projects as opposed to estimating economic impacts of unmet water needs. Nevertheless, one could include some impacts measured in this study as part of a benefit cost study if done so properly. Since this is not a benefit cost analysis, future impacts are not weighted differently. In other words, estimates are not discounted. If used as a measure of economic benefits, one should incorporate a measure of uncertainty into the analysis. In this type of analysis, a typical method of discounting future values is to assign probabilities of the drought of record recurring again in a given year, and weight monetary impacts accordingly. This analysis assumes a probability of one.

4. IO multipliers measure the strength of backward linkages to supporting industries (i.e., those who sell inputs to an affected sector). However, multipliers say nothing about forward linkages consisting of businesses that purchase goods from an affected sector for further processing. For example, ranchers in many areas sell most of their animals to local meat packers who process animals into a form that consumers ultimately see in grocery stores and restaurants. Multipliers do not capture forward linkages to meat packers, and since meat packers sell livestock purchased from ranchers as "final sales," multipliers for the ranching sector do fully account for all losses to a region's economy. Thus, as mentioned previously, in some cases closely linked sectors were moved from one water use category to another.

5. Cautions regarding interpretations of direct and secondary impacts are warranted. IO/SAM multipliers are based on "fixed-proportion production functions," which basically means that input use - including labor - moves in lockstep fashion with changes in levels of output. In a

scenario where output (i.e., sales) declines, losses in the immediate sector or supporting sectors could be much less than predicted by an IO/SAM model for several reasons. For one, businesses will likely expect to continue operating so they might maintain spending on inputs for future use; or they may be under contractual obligations to purchase inputs for an extended period regardless of external conditions. Also, employers may not lay-off workers given that experienced labor is sometimes scarce and skilled personnel may not be readily available when water shortages subside. Lastly people who lose jobs might find other employment in the region. As a result, direct losses for employment and secondary losses in sales and employment should be considered an upper bound. Similarly, since projected population losses are based on reduced employment in the region, they should be considered an upper bound as well.

6. IO models are static. Models and resultant multipliers are based upon the structure of the U.S. and regional economies in 2006. In contrast, water shortages are projected to occur well into the future. Thus, the analysis assumes that the general structure of the economy remains the same over the planning horizon, and the farther out into the future we go, this assumption becomes less reliable.

7. Impacts are annual estimates. If one were to assume that conditions persisted for more than one year, figures should be adjusted to reflect the extended duration. The drought of record in most regions of Texas lasted several years.

8. Monetary figures are reported in constant year 2006 dollars.

1.1.2 Impacts to Agriculture

Irrigated Crop Production

The first step in estimating impacts to irrigation required calculating gross sales for IMPLAN crop sectors. Default IMPLAN data do not distinguish irrigated production from dry-land production. Once gross sales were known other statistics such as employment and income were derived using IMPLAN direct multiplier coefficients. Gross sales for a given crop are based on two data sources:

1) county-level statistics collected and maintained by the TWDB and the USDA Farm Services Agency (FSA) including the number of irrigated acres by crop type and water application per acre, and

2) regional-level data published by the Texas Agricultural Statistics Service (TASS) including prices received for crops (marketing year averages), crop yields and crop acreages.

Crop categories used by the TWDB differ from those used in IMPLAN datasets. To maintain consistency, sales and other statistics are reported using IMPLAN crop classifications. Table 1 shows the TWDB crops included in corresponding IMPLAN sectors, and Table 2 summarizes acreage and estimated annual water use for each crop classification (five-year average from 2003-2007). Table 3 displays average (2003-2007) gross revenues per acre for IMPLAN crop categories.

Table 1: Crop Classifications Used in TWDB Water Use Survey and Corresponding IMPLAN Crop Sectors	
IMPLAN Category	**TWDB Category**
Oilseeds	Soybeans and other oil crops
Grains	Grain sorghum, corn, wheat and other grain crops
Vegetable and melons	Vegetables and potatoes
Tree nuts	Pecans
Fruits	Citrus, vineyard and other orchard
Cotton	Cotton
Sugarcane and sugar beets	Sugarcane and sugar beets
All “other” crops	Forage crops, peanuts, alfalfa, hay and pasture, rice and all other crops

Table 2: Summary of Irrigated Crop Acreage and Water Demand for the Far West Texas Regional Water Planning Area (average 2003-2007)

Sector	Acres (1000s)	Distribution of acres	Water use (1000s of AF)	Distribution of water use
Oilseeds	0.014	< 1%	0.034	<1%
Grains	5.19	5%	12.67	4%
Vegetable and melons	6.02	6%	15.62	4%
Tree nuts	12.26	13%	57.52	16%
Fruits	1.62	2%	3.7	1%
Cotton	32.57	34%	119.49	33%
Sugarcane and sugar beets	0.00	0%	0.00	0%
All other crops	37.51	39%	152.07	42%
Total	95.18	100%	361.12	100%

Source: Water demand figures are a 5- year average (2003-2007) of the TWDB’s annual Irrigation Water Use Estimates. Statistics for irrigated crop acreage are based upon annual survey data collected by the TWDB and the Farm Service Agency. Values do not include acreage or water use for the TWDB categories classified by the Farm Services Agency as “failed acres,” “golf course” or “waste water.”

Table 3: Average Gross Sales Revenues per Acre for Irrigated Crops for the Far West Texas Regional Water Planning Area (2003-2007)		
IMPLAN sector	**Gross revenues per acre**	**Crops included in estimates**
Oilseeds	$437	Based on five-year (2003-2007) average weighted by acreage for "irrigated soybeans" and "irrigated other oil crops."
Grains	$175	Based on five-year (2003-2007) average weighted by acreage for "irrigated grain sorghum," "irrigated corn", "irrigated wheat" and "irrigated 'other' grain crops."
Vegetable and melons	$6,265	Based on five-year (2003-2007) average weighted by acreage for "irrigated shallow and deep root vegetables," "irrigated Irish potatoes" and "irrigated melons."
Tree nuts	$3,558	Based on five-year (2003-2007) average weighted by acreage for "irrigated pecans."
Fruits	$6,134	Based on five-year (2003-2007) average weighted by acreage for "irrigated citrus," "irrigated vineyards" and "irrigated 'other' orchard."
Cotton	$513	Based on five-year (2003-2007) average weighted by acreage for "irrigated cotton."
Sugarcane and sugar beets	$528	Irrigated figure is based on five-year (2003-2007) average weighted by acreage for "irrigated 'forage' crops", "irrigated peanuts", "irrigated alfalfa," "irrigated 'hay' and pasture" and "irrigated 'all other' crops."

*Figures are rounded. Source: Based on data from the Texas Agricultural Statistics Service, Texas Water Development Board, and Texas A&M University.

An important consideration when estimating impacts to irrigation was determining which crops are affected by water shortages. One approach is the so-called rationing model, which assumes that farmers respond to water supply cutbacks by fallowing the lowest value crops in the region first and the highest valued crops last until the amount of water saved equals the shortage.[5] For example, if farmer A grows vegetables (higher value) and farmer B grows wheat (lower value) and they both face a proportionate cutback in irrigation water, then farmer B will sell water to farmer A. Farmer B will fallow her irrigated acreage before farmer A fallows anything. Of course, this assumes that farmers can and do transfer enough water to allow this to happen. A different approach involves constructing farm-level profit maximization models that conform to widely-accepted economic theory that farmers make decisions based on marginal net returns. Such models have good predictive capability, but data requirements and complexity are high. Given that a detailed analysis for each region would require a substantial amount of farm-level data and analysis, the following investigation assumes that projected shortages are distributed equally across predominant crops in the region. Predominant in this case are crops that comprise at least one percent of total acreage in the region.

The following steps outline the overall process used to estimate direct impacts to irrigated agriculture:

1. *Distribute shortages across predominant crop types in the region*. Again, unmet water needs were distributed equally across crop sectors that constitute one percent or more of irrigated acreage.

2. *Estimate associated reductions in output for affected crop sectors*. Output reductions are based on elasticities discussed previously and on estimated values per acre for different crops. Values per acre stem from the same data used to estimate output for the year 2006 baseline. Using multipliers, we then generate estimates of forgone income, jobs, and tax revenues based on reductions in gross sales and final demand.

Livestock

The approach used for the livestock sector is basically the same as that used for crop production. As is the case with crops, livestock categorizations used by the TWDB differ from those used in IMPLAN datasets, and TWDB groupings were assigned to a given IMPLAN sector (Table 4). Then we:

1) *Distribute projected water needs equally among predominant livestock sectors and estimate lost output*: As is the case with irrigation, shortages are assumed to affect all livestock sectors equally; however, the category of "other" is not included given its small size. If water needs were small relative to total demands, we assume that producers would haul in water by truck to fill stock tanks. The cost per acre-foot ($24,000) is based on 2008 rates charged by various water haulers in Texas, and assumes that the average truck load is 6,500 gallons at a hauling distance of 60 miles.

3) *Estimate reduced output in forward processors for livestock sectors*. Reductions in output for livestock sectors are assumed to have a proportional impact on forward processors in the region such as meat packers. In other words, if the cows were gone, meat-packing plants or fluid milk manufacturers) would likely have little to process. This is not an unreasonable premise. Since the

[5] The rationing model was initially proposed by researchers at the University of California at Berkeley, and was then modified for use in a study conducted by the U.S. Environmental Protection Agency that evaluated how proposed water supply cutbacks recommended to protect water quality in the Bay/Delta complex in California would affect farmers in the Central Valley. See, Zilberman, D., Howitt, R. and Sunding, D. "*Economic Impacts of Water Quality Regulations in the San Francisco Bay and Delt*a." Western Consortium for Public Health. May 1993.

1950s, there has been a major trend towards specialized cattle feedlots, which in turn has decentralized cattle purchasing from livestock terminal markets to direct sales between producers and slaughterhouses. Today, the meat packing industry often operates large processing facilities near high concentrations of feedlots to increase capacity utilization.[6] As a result, packers are heavily dependent upon nearby feedlots. For example, a recent study by the USDA shows that on average meat packers obtain 64 percent of cattle from within 75 miles of their plant, 82 percent from within 150 miles and 92 percent from within 250 miles.[7]

Table 4: Description of Livestock Sectors

IMPLAN category	TWDB category
Cattle ranching and farming	Cattle, cow calf, feedlots and dairies
Poultry and egg production	Poultry production.
Other livestock	Livestock other than cattle and poultry (i.e., horses, goats, sheep, hogs)
Milk manufacturing	Fluid milk manufacturing, cheese manufacturing, ice cream manufacturing etc.
Meat packing	Meat processing present in the region from slaughter to final processing

1.1.3 Impacts to Municipal Water User Groups

Disaggregation of Municipal Water Demands

Estimating the economic impacts for the municipal water user groups is complicated for a number of reasons. For one, municipal use comprises a range of consumers including commercial businesses, institutions such as schools and government and households. However, reported water needs are not distributed among different municipal water users. In other words, how much of a municipal need is commercial and how much is residential (domestic)?

The amount of commercial water use as a percentage of total municipal demand was estimated based on “GED” coefficients (gallons per employee per day) published in secondary sources.[8] For example, if year 2006 baseline data for a given economic sector (e.g., amusement and recreation services) shows employment at 30 jobs and the GED coefficient is 200, then average daily water use by that sector is (30 x

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[6] Ferreira, W.N. “*Analysis of the Meat Processing Industry in the United States*.” Clemson University Extension Economics Report ER211, January 2003.

[7] Ward, C.E. “*Summary of Results from USDA’s Meatpacking Concentration Study*.” Oklahoma Cooperative Extension Service, OSU Extension Facts WF-562.

[8] Sources for GED coefficients include: Gleick, P.H., Haasz, D., Henges-Jeck, C., Srinivasan, V., Wolff, G. Cushing, K.K., and Mann, A. "*Waste Not, Want Not*: *The Potential for Urban Water Conservation in California*." Pacific Institute. November 2003. U.S. Bureau of the Census. 1982 Census of Manufacturers: Water Use in Manufacturing. USGPO, Washington D.C. See also: “*U.S. Army Engineer Institute for Water Resources, IWR Report 88-R-6.*,” Fort Belvoir, VA. See also, Joseph, E. S., 1982, "*Municipal and Industrial Water Demands of the Western United States*." Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, v. 108, no. WR2, p. 204-216. See also, Baumann, D. D., Boland, J. J., and Sims, J. H., 1981, “*Evaluation of Water Conservation for Municipal and Industrial Water Supply*.” U.S. Army Corps of Engineers, Institute for Water Resources, Contract no. 82-C1.

200 = 6,000 gallons) or 6.7 acre-feet per year. Water not attributed to commercial use is considered domestic, which includes single and multi-family residential consumption, institutional uses and all use designated as "county-other." Based on our analysis, commercial water use is about 5 to 35 percent of municipal demand. Less populated rural counties occupy the lower end of the spectrum, while larger metropolitan counties are at the higher end.

After determining the distribution of domestic versus commercial water use, we developed methods for estimating impacts to the two groups.

Domestic Water Uses

Input output models are not well suited for measuring impacts of shortages for domestic water uses, which make up the majority of the municipal water use category. To estimate impacts associated with domestic water uses, municipal water demand and needs are subdivided into residential, and commercial and institutional use. Shortages associated with residential water uses are valued by estimating proxy demand functions for different water user groups allowing us to estimate the marginal value of water, which would vary depending upon the level of water shortages. The more severe the water shortage, the more costly it becomes. For instance, a 2 acre-foot shortage for a group of households that use 10 acre-feet per year would not be as severe as a shortage that amounted to 8 acre-feet. In the case of a 2 acre-foot shortage, households would probably have to eliminate some or all outdoor water use, which could have implicit and explicit economic costs including losses to the horticultural and landscaping industry. In the case of an 8 acre-foot shortage, people would have to forgo all outdoor water use and most indoor water consumption. Economic impacts would be much higher in the latter case because people, and would be forced to find emergency alternatives assuming alternatives were available.

To estimate the value of domestic water uses, TWDB staff developed marginal loss functions based on constant elasticity demand curves. This is a standard and well-established method used by economists to value resources such as water that have an explicit monetary cost.

A constant price elasticity of demand is estimated using a standard equation:

$$w = kc^{(-\varepsilon)}$$

where:

- w is equal to average monthly residential water use for a given water user group measured in thousands of gallons;
- k is a constant intercept;
- c is the average cost of water per 1,000 gallons; and
- ε is the price elasticity of demand.

Price elasticities (-0.30 for indoor water use and -0.50 for outdoor use) are based on a study by Bell et al.[9] that surveyed 1,400 water utilities in Texas that serve at least 1,000 people to estimate demand elasticity for several variables including price, income, weather etc. Costs of water and average use per month per household are based on data from the Texas Municipal League's annual water and

[9] Bell, D.R. and Griffin, R.C. "*Community Water Demand in Texas as a Century is Turned*." Research contract report prepared for the Texas Water Development Board. May 2006.

wastewater rate surveys - specifically average monthly household expenditures on water and wastewater in different communities across the state. After examining variance in costs and usage, three different categories of water user groups based on population (population less than 5,000, cities with populations ranging from 5,000 to 99,999 and cities with populations exceeding 100,000) were selected to serve as proxy values for municipal water groups that meet the criteria (Table 5).[10]

Table 5: Water Use and Costs Parameters Used to Estimated Water Demand Functions
(average monthly costs per acre-foot for delivered water and average monthly use per household)

Community population	Water	Wastewater	Total monthly cost	Avg. monthly use (gallons)
Less than or equal to 5,000	$1,335	$1,228	$2,563	6,204
5,000 to 100,000	$1,047	$1,162	$2,209	7,950
Great than or equal to 100,000	$718	$457	$1,190	8,409

Source: Based on annual water and wastewater rate surveys published by the Texas Municipal League.

As an example, Table 6 shows the economic impact per acre-foot of domestic water needs for municipal water user groups with population exceeding 100,000 people. There are several important assumptions incorporated in the calculations:

1) Reported values are net of the variable costs of treatment and distribution such as expenses for chemicals and electricity since using less water involves some savings to consumers and utilities alike; and for outdoor uses we do not include any value for wastewater.

2) Outdoor and "non-essential" water uses would be eliminated before indoor water consumption was affected, which is logical because most water utilities in Texas have drought contingency plans that generally specify curtailment or elimination of outdoor water use during droughts.[11] Determining how much water is used for outdoor purposes is based on several secondary sources. The first is a major study sponsored by the American Water Works Association, which surveyed cities in states including Colorado, Oregon, Washington, California, Florida and Arizona. On average across all cities surveyed 58 percent of single family residential water use was for outdoor activities. In cities with climates comparable to large metropolitan areas of Texas, the average was 40 percent.[12] Earlier findings of the U.S. Water Resources Council showed a national

[10] Ideally, one would want to estimate demand functions for each individual utility in the state. However, this would require an enormous amount of time and resources. For planning purposes, we believe the values generated from aggregate data are more than sufficient.

[11] In Texas, state law requires retail and wholesale water providers to prepare and submit plans to the Texas Commission on Environmental Quality (TCEQ). Plans must specify demand management measures for use during drought including curtailment of "non-essential water uses." Non-essential uses include, but are not limited to, landscape irrigation and water for swimming pools or fountains. For further information see the Texas Environmental Quality Code §288.20.

[12] See, Mayer, P.W., DeOreo, W.B., Opitz, E.M., Kiefer, J.C., Davis, W., Dziegielewski, D., Nelson, J.O. "*Residential End Uses of Water*." Research sponsored by the American Water Works Association and completed by Aquacraft, Inc. and Planning and Management Consultants, Ltd. (PMCL@CDM).

average of 33 percent. Similarly, the United States Environmental Protection Agency (USEPA) estimated that landscape watering accounts for 32 percent of total residential and commercial water use on annual basis.[13] A study conducted for the California Urban Water Agencies (CUWA) calculated average annual values ranging from 25 to 35 percent.[14] Unfortunately, there does not appear to be any comprehensive research that has estimated non-agricultural outdoor water use in Texas. As an approximation, an average annual value of 30 percent based on the above references was selected to serve as a rough estimate in this study.

3) As shortages approach 100 percent values become immense and theoretically infinite at 100 percent because at that point death would result, and willingness to pay for water is immeasurable. Thus, as shortages approach 80 percent of monthly consumption, we assume that households and non-water intensive commercial businesses (those that use water only for drinking and sanitation would have water delivered by tanker truck or commercial water delivery companies. Based on reports from water companies throughout the state, we estimate that the cost of trucking in water is around $21,000 to $27,000 per acre-feet assuming a hauling distance of between 20 to 60 miles. This is not an unreasonable assumption. The practice was widespread during the 1950s drought and recently during droughts in this decade. For example, in 2000 at the heels of three consecutive drought years Electra - a small town in North Texas - was down to its last 45 days worth of reservoir water when rain replenished the lake, and the city was able to refurbish old wells to provide supplemental groundwater. At the time, residents were forced to limit water use to 1,000 gallons per person per month - less than half of what most people use - and many were having water delivered to their homes by private contractors.[15] In 2003 citizens of Ballinger, Texas, were also faced with a dwindling water supply due to prolonged drought. After three years of drought, Lake Ballinger, which supplies water to more than 4,300 residents in Ballinger and to 600 residents in nearby Rowena, was almost dry. Each day, people lined up to get water from a well in nearby City Park. Trucks hauling trailers outfitted with large plastic and metal tanks hauled water to and from City Park to Ballinger.[16]

[13] U.S. Environmental Protection Agency. *"Cleaner Water through Conservation*." USEPA Report no. 841-B-95-002. April, 1995.

[14] Planning and Management Consultants, Ltd. "*Evaluating Urban Water Conservation Programs: A Procedures Manual*." Prepared for the California Urban Water Agencies. February 1992.

[15] Zewe, C. "*Tap Threatens to Run Dry in Texas Town*." July 11, 2000. CNN Cable News Network.

[16] Associated Press, "*Ballinger Scrambles to Finish Pipeline before Lake Dries Up*." May 19, 2003.

Table 6: Economic Losses Associated with Domestic Water Shortages in Communities with Populations Exceeding 100,000 people				
Water shortages as a percentage of total monthly household demands	**No. of gallons remaining per household per day**	**No of gallons remaining per person per day**	**Economic loss (per acre-foot)**	**Economic loss (per gallon)**
1%	278	93	$748	$0.00005
5%	266	89	$812	$0.0002
10%	252	84	$900	$0.0005
15%	238	79	$999	$0.0008
20%	224	75	$1,110	$0.0012
25%	210	70	$1,235	$0.0015
30%[a]	196	65	$1,699	$0.0020
35%	182	61	$3,825	$0.0085
40%	168	56	$4,181	$0.0096
45%	154	51	$4,603	$0.011
50%	140	47	$5,109	$0.012
55%	126	42	$5,727	$0.014
60%	112	37	$6,500	$0.017
65%	98	33	$7,493	$0.02
70%	84	28	$8,818	$0.02
75%	70	23	$10,672	$0.03
80%	56	19	$13,454	$0.04
85%	42	14	$18,091 ($24,000)[b]	$0.05 ($0.07)[b]
90%	28	9	$27,363 ($24,000)	$0.08 ($0.07)
95%	14	5	$55,182 ($24,000)	$0.17 ($0.07)
99%	3	0.9	$277,728 ($24,000)	$0.85 ($0.07)
99.9%	1	0.5	$2,781,377 ($24,000)	$8.53 ($0.07)
100%	0	0	Infinite ($24,000)	Infinite ($0.07)

[a] The first 30 percent of needs are assumed to be restrictions of outdoor water use; when needs reach 30 percent of total demands all outdoor water uses would be restricted. Needs greater than 30 percent include indoor use.

[b] As shortages approach 100 percent the value approaches infinity assuming there are not alternatives available; however, we assume that communities would begin to have water delivered by tanker truck at an estimated cost of $24,000 per acre-foot when shortages breached 85 percent.

Commercial Businesses

Effects of water shortages on commercial sectors were estimated in a fashion similar to other business sectors meaning that water shortages would affect the ability of these businesses to operate. This is particularly true for "water intensive" commercial sectors that are need large amounts of water (in addition to potable and sanitary water) to provide their services. These include:

- car-washes,
- laundry and cleaning facilities,
- sports and recreation clubs and facilities including race tracks,
- amusement and recreation services,
- hospitals and medical facilities,
- hotels and lodging places, and
- eating and drinking establishments.

A key assumption is that commercial operations would not be affected until water shortages were at least 50 percent of total municipal demand. In other words, we assume that residential water consumers would reduce water use including all non-essential uses before businesses were affected.

An example will illustrate the breakdown of municipal water needs and the overall approach to estimating impacts of municipal needs. Assume City A experiences an unexpected shortage of 50 acre-feet per year when their demands are 200 acre-feet per year. Thus, shortages are only 25 percent of total municipal use and residents of City A could eliminate needs by restricting landscape irrigation. City B, on the other hand, has a deficit of 150 acre-feet in 2020 and a projected demand of 200 acre-feet. Thus, total shortages are 75 percent of total demand. Emergency outdoor and some indoor conservation measures could eliminate 50 acre-feet of projected needs, yet 50 acre-feet would still remain. To eliminate" the remaining 50 acre-feet water intensive commercial businesses would have to curtail operations or shut down completely.

Three other areas were considered when analyzing municipal water shortages: 1) lost revenues to water utilities, 2) losses to the horticultural and landscaping industries stemming for reduction in water available for landscape irrigation, and 3) lost revenues and related economic impacts associated with reduced water related recreation.

Water Utility Revenues

Estimating lost water utility revenues was straightforward. We relied on annual data from the "*Water and Wastewater Rate Survey*" published annually by the Texas Municipal League to calculate an average value per acre-foot for water and sewer. For water revenues, average retail water and sewer rates multiplied by total water needs served as a proxy. For lost wastewater, total unmet needs were adjusted for return flow factor of 0.60 and multiplied by average sewer rates for the region. Needs reported as "county-other" were excluded under the presumption that these consist primarily of self-supplied water uses. In addition, 15 percent of water demand and needs are considered non-billed or "unaccountable" water that comprises things such as leakages and water for municipal government functions (e.g., fire departments). Lost tax receipts are based on current rates for the "miscellaneous gross receipts tax, "which the state collects from utilities located in most incorporated cities or towns in Texas. We do not include lost water utility revenues when aggregating impacts of municipal water shortages to regional and state levels to prevent double counting.

Horticultural and Landscaping Industry

The horticultural and landscaping industry, also referred to as the "green Industry," consists of businesses that produce, distribute and provide services associated with ornamental plants, landscape and garden supplies and equipment. Horticultural industries often face big losses during drought. For example, the recent drought in the Southeast affecting the Carolinas and Georgia horticultural and landscaping businesses had a harsh year. Plant sales were down, plant mortality increased, and watering costs increased. Many businesses were forced to close locations, lay off employees, and even file for bankruptcy. University of Georgia economists put statewide losses for the industry at around $3.2 billion during the 3-year drought that ended in 2008.[17] Municipal restrictions on outdoor watering play a significant role. During drought, water restrictions coupled with persistent heat has a psychological effect on homeowners that reduces demands for landscaping products and services. Simply put, people were afraid to spend any money on new plants and landscaping.

In Texas, there do not appear to be readily available studies that analyze the economic effects of water shortages on the industry. However, authors of this report believe negative impacts do and would result in restricting landscape irrigation to municipal water consumers. The difficulty in measuring them is two-fold. First, as noted above, data and research for these types of impacts that focus on Texas are limited; and second, economic data provided by IMPLAN do not disaggregate different sectors of the green industry to a level that would allow for meaningful and defensible analysis.[18]

Recreational Impacts

Recreational businesses often suffer when water levels and flows in rivers, springs and reservoirs fall significantly during drought. During droughts, many boat docks and lake beaches are forced to close, leading to big losses for lakeside business owners and local communities. Communities adjacent to popular river and stream destinations such as Comal Springs and the Guadalupe River also see their business plummet when springs and rivers dry up. Although there are many examples of businesses that have suffered due to drought, dollar figures for drought-related losses to the recreation and tourism industry are not readily available, and very difficult to measure without extensive local surveys. Thus, while they are important, economic impacts are not measured in this study.

Table 7 summarizes impacts of municipal water shortages at differing levels of magnitude, and shows the ranges of economic costs or losses per acre-foot of shortage for each level.

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[17] Williams, D. *"Georgia landscapers eye rebound from Southeast drought."* Atlanta Business Chronicle, Friday, June 19, 2009

[18] Economic impact analyses prepared by the TWDB for 2006 regional water plans did include estimates for the horticultural industry. However, year 2000 and prior IMPLAN data were disaggregated to a finer level. In the current dataset (2006), the sector previously listed as "Landscaping and Horticultural Services" (IMPLAN Sector 27) is aggregated into "Services to Buildings and Dwellings" (IMPLAN Sector 458).

Table 7: Impacts of Municipal Water Shortages at Different Magnitudes of Shortages		
Water shortages as percent of total municipal demands	Impacts	Economic costs per acre-foot*
0-30%	✓ Lost water utility revenues ✓ Restricted landscape irrigation and non-essential water uses	$730 - $2,040
30-50%	✓ Lost water utility revenues ✓ Elimination of landscape irrigation and non-essential water uses ✓ Rationing of indoor use	$2,040 - $10,970
>50%	✓ Lost water utility revenues ✓ Elimination of landscape irrigation and non-essential water uses ✓ Rationing of indoor use ✓ Restriction or elimination of commercial water use ✓ Importing water by tanker truck	$10,970 - varies
*Figures are rounded		

1.1.4 Industrial Water User Groups

Manufacturing

Impacts to manufacturing were estimated by distributing water shortages among industrial sectors at the county level. For example, if a planning group estimates that during a drought of record water supplies in County A would only meet 50 percent of total annual demands for manufactures in the county, we reduced output for each sector by 50 percent. Since projected manufacturing demands are based on TWDB Water Uses Survey data for each county, we only include IMPLAN sectors represented in the TWBD survey database. Some sectors in IMPLAN databases are not part of the TWDB database given that they use relatively small amounts of water - primarily for on-site sanitation and potable purposes. To maintain consistency between IMPLAN and TWDB databases, Standard Industrial Classification (SIC) codes both databases were cross referenced in county with shortages. Non-matches were excluded when calculating direct impacts.

Mining

The process of mining is very similar to that of manufacturing. We assume that within a given county, shortages would apply equally to relevant mining sectors, and IMPLAN sectors are cross referenced with TWDB data to ensure consistency.

In Texas, oil and gas extraction and sand and gravel (aggregates) operations are the primary mining industries that rely on large volumes of water. For sand and gravel, estimated output reductions are straightforward; however, oil and gas is more complicated for a number of reasons. IMPLAN does not necessarily report the physical extraction of minerals by geographic local, but rather the sales revenues reported by a particular corporation.

For example, at the state level revenues for IMPLAN sector 19 (oil and gas extraction) and sector 27 (drilling oil and gas wells) totals $257 billion. Of this, nearly $85 billion is attributed to Harris County. However, only a very small fraction (less than one percent) of actual production takes place in the county. To measure actual potential losses in well head capacity due to water shortages, we relied on county level production data from the Texas Railroad Commission (TRC) and average well-head market prices for crude and gas to estimate lost revenues in a given county. After which, we used to IMPLAN ratios to estimate resultant losses in income and employment.

Other considerations with respect to mining include:

1) Petroleum and gas extraction industry only uses water in significant amounts for secondary recovery. Known in the industry as enhanced or water flood extraction, secondary recovery involves pumping water down injection wells to increase underground pressure thereby pushing oil or gas into other wells. IMPLAN output numbers do not distinguish between secondary and non-secondary recovery. To account for the discrepancy, county-level TRC data that show the proportion of barrels produced using secondary methods were used to adjust IMPLAN data to reflect only the portion of sales attributed to secondary recovery.

2) A substantial portion of output from mining operations goes directly to businesses that are classified as manufacturing in our schema. Thus, multipliers measuring backward linkages for a given manufacturer might include impacts to a supplying mining operation. Care was taken not to double count in such situations if both a mining operation and a manufacturer were reported as having water shortages.

Steam-electric

At minimum without adequate cooling water, power plants cannot safely operate. As water availability falls below projected demands, water levels in lakes and rivers that provide cooling water would also decline. Low water levels could affect raw water intakes and outfalls at electrical generating units in several ways. For one, power plants are regulated by thermal emission guidelines that specify the maximum amount of heat that can go back into a river or lake via discharged cooling water. Low water levels could result in permit compliance issues due to reduced dilution and dispersion of heat and subsequent impacts on aquatic biota near outfalls.[19] However, the primary concern would be a loss of head (i.e., pressure) over intake structures that would decrease flows through intake tunnels. This would affect safety related pumps, increase operating costs and/or result in sustained shut-downs. Assuming plants did shutdown, they would not be able to generate electricity.

[19] Section 316 (b) of the Clean Water Act requires that thermal wastewater discharges do not harm fish and other wildlife.

Among all water use categories steam-electric is unique and cautions are needed when applying methods used in this study. Measured changes to an economy using input-output models stem directly from changes in sales revenues. In the case of water shortages, one assumes that businesses will suffer lost output if process water is in short supply. For power generation facilities this is true as well. However, the electric services sector in IMPLAN represents a corporate entity that may own and operate several electrical generating units in a given region. If one unit became inoperable due to water shortages, plants in other areas or generation facilities that do not rely heavily on water such as gas powered turbines might be able to compensate for lost generating capacity. Utilities could also offset lost production via purchases on the spot market.[20] Thus, depending upon the severity of the shortages and conditions at a given electrical generating unit, energy supplies for local and regional communities could be maintained. But in general, without enough cooling water, utilities would have to throttle back plant operations, forcing them to buy or generate more costly power to meet customer demands.

Measuring impacts end users of electricity is not part of this study as it would require extensive local and regional level analysis of energy production and demand. To maintain consistency with other water user groups, impacts of steam-electric water shortages are measured in terms of lost revenues (and hence income) and jobs associated with shutting down electrical generating units.

1.2 Social Impacts of Water Shortages

As the name implies, the effects of water shortages can be social or economic. Distinctions between the two are both semantic and analytical in nature – more so analytic in the sense that social impacts are harder to quantify. Nevertheless, social effects associated with drought and water shortages are closely tied to economic impacts. For example, they might include:

- demographic effects such as changes in population,
- disruptions in institutional settings including activity in schools and government,
- conflicts between water users such as farmers and urban consumers,
- health-related low-flow problems (e.g., cross-connection contamination, diminished sewage flows, increased pollutant concentrations),
- mental and physical stress (e.g., anxiety, depression, domestic violence),
- public safety issues from forest and range fires and reduced fire fighting capability,
- increased disease caused by wildlife concentrations,
- loss of aesthetic and property values, and
- reduced recreational opportunities.[21]

[20] Today, most utilities participate in large interstate "power pools" and can buy or sell electricity "on the grid" from other utilities or power marketers. Thus, assuming power was available to buy, and assuming that no contractual or physical limitations were in place such as transmission constraints; utilities could offset lost power that resulted from waters shortages with purchases via the power grid.

[21] Based on information from the website of the National Drought Mitigation Center at the University of Nebraska Lincoln. Available online at: http://www.drought.unl.edu/risk/impacts.htm. See also, Vanclay, F. "*Social Impact Assessment*." in Petts, J. (ed) International Handbook of Environmental Impact Assessment. 1999.

Social impacts measured in this study focus strictly on demographic effects including changes in population and school enrollment. Methods are based on demographic projection models developed by the Texas State Data Center and used by the TWDB for state and regional water planning. Basically, the social impact model uses results from the economic component of the study and assesses how changes in labor demand would affect migration patterns in a region. Declines in labor demand as measured using adjusted IMPLAN data are assumed to affect net economic migration in a given regional water planning area. Employment losses are adjusted to reflect the notion that some people would not relocate but would seek employment in the region and/or public assistance and wait for conditions to improve. Changes in school enrollment are simply the proportion of lost population between the ages of 5 and 17.

2.0 Results

Section 2 presents the results of the analysis at the regional level. Included are baseline economic data for each water use category, and estimated economic impacts of water shortages for water user groups with deficits. According to the 2011 *Far West Texas Regional Water Plan*, during severe drought irrigation, municipal, manufacturing, mining and steam-electric water user groups would experience water shortages in the absence of new water management strategies.

2.1 Overview of Regional Economy

The Region E economy generates about $33 billion in gross state product for Texas ($30 billion worth of income and $3 billion in business taxes), and supports 377,702 jobs (Table 8). Agriculture and manufacturing (particularly petroleum refining, copper smelting and automotive parts), are the primary base economic sectors.[22] Municipal sectors also generate substantial amounts of income – about $25 billion per year. While municipal sectors are the largest employer and source of income, many businesses that make up the municipal category such as restaurants and retail stores are non-basic industries meaning they exist to provide services to people who work would in base industries such as manufacturing, agriculture and mining. In other words, without base industries such agriculture, many municipal jobs in the region would not exist.

[22] Base industries are those that supply markets outside of the region. These industries are crucial to the local economy and are called the economic base of a region. Appendix A shows how IMPLAN's 529 sectors were allocated to water use category, and shows economic data for each sector.

Table 8: The Far West Texas Regional Economy by Water User Group ($millions)						
Water Use Category	**Total sales**	**Intermediate sales**	**Final sales**	**Jobs**	**Income**	**Business taxes**
Irrigation	$141.10	$62.28	$76.67	1,694	$87.73	$2.38
Livestock	$196.88	$46.10	$150.78	236	$47.11	$1.44
Manufacturing	$13,039.47	$2,747.78	$10,291.68	41,061	$3,788.27	$114.36
Mining	$184.65	$116.35	$68.30	$360.00	$98.28	$10.02
Steam-electric	$384.76	$108.24	$276.52	837	$267.12	$45.65
Municipal	$45,429.48	$16,572.52	$28,856.96	333,514	$25,501.39	$2,442.99
Regional total	$59,376.34	$19,653.27	$39,720.91	377,702	$29,789.90	$2,616.84

Based on data from the Texas Water Development Board, and year 2006 data from the Minnesota IMPLAN Group, Inc.

2.2 Impacts of Agricultural Water Shortages

According to the 2011 *Far West Texas Regional Water Plan*, during severe drought Hudspeth and El Paso counties would experiences irrigation shortages. In 2010, shortages range from 23 to 54 percent of annual irrigation demands. Deficits of this magnitude would decrease gross state product (income plus taxes) by an estimated $40 million dollars in 2010 and $23 million in 2060 (Table 9).

Table 9: Economic Impacts of Water Shortages for Irrigation Water User Groups ($millions)			
Decade	**Lost income from reduced crop production [a]**	**Lost state and local tax revenues from reduced crop production**	**Lost jobs from reduced crop production**
		Hudspeth County	
2010	$23.76	$1.37	142
2020	$11.42	$0.66	136
2030	$10.98	$0.63	131
2040	$10.54	$0.61	126
2050	$10.11	$0.58	120
2060	$9.69	$0.56	115
		El Paso County	
2010	$16.80	$1.03	198
2020	$15.82	$0.97	187
2030	$15.37	$0.95	181
2040	$13.43	$0.83	158
2050	$12.56	$0.77	148
2060	$11.70	$0.72	138
		Regional Totals	
2010	$40.56	$2.40	340
2020	$27.24	$1.63	323
2030	$26.35	$1.58	312
2040	$23.97	$1.43	284
2050	$22.67	$1.36	269
2060	$21.39	$1.28	254

[a] Changes to Income and business taxes are collectively equivalent to a decrease in gross state product, which is analogous to gross domestic product measured at the state rather than national level.

2.3 Impacts of Municipal Water Shortages

Water shortages are projected to occur in eight municipal water user groups in the planning region. Deficits range from 5 to 69 percent of total annual water use. At a regional level, monetary losses associated with domestic water shortages total $48 million in 2020 and rise to nearly $402 million in 2060 (Table 10). Curtailment of commercial business activity would reduce gross state product by an estimated $2 million in 2030 and $55 million in 2060.

Table 10: Economic Impacts of Water Shortages for Municipal Water User Groups ($millions)					
Decade	Monetary value of domestic water shortages	Lost income from reduced commercial business activity	Lost state and local taxes from reduced commercial business activity	Lost jobs from reduced commercial business activity	Lost water utility revenues
City of El Paso					
2010	$0.00	$0.00	$0.00	0	$0.00
2020	$0.00	$0.00	$0.00	0	$0.00
2030	$0.00	$0.00	$0.00	0	$0.00
2040	$0.00	$0.00	$0.00	0	$0.00
2050	$3.94	$0.00	$0.00	0	$9.62
2060	$12.33	$0.00	$0.00	0	$27.12
County-other					
2010	$0.00	$0.00	$0.00	0	$0.00
2020	$25.71	$0.00	$0.00	0	$0.00
2030	$61.69	$0.00	$0.00	0	$0.00
2040	$93.13	$0.00	$0.00	0	$0.00
2050	$133.24	$0.00	$0.00	0	$0.00
2060	$190.00	$0.00	$0.00	0	$0.00
Horizon Regional Municipal Utility District					
2010	$0.00	$0.00	$0.00	0	$0.00
2020	$8.49	$0.00	$0.00	0	$3.18
2030	$25.84	$0.00	$0.00	0	$6.54
2040	$39.17	$4.94	$0.53	110	$9.44
2050	$69.15	$16.68	$1.78	371	$12.37
2060	$84.74	$23.49	$2.50	523	$15.30
Lower Valley Water District					
2010	$0.00	$0.00	$0.00	0	$0.00
2020	$4.26	$0.00	$0.00	0	$1.20
2030	$9.05	$0.85	$0.12	27	$2.30
2040	$13.72	$3.04	$0.43	96	$3.18
2050	$21.34	$4.48	$0.64	141	$4.12
2060	$31.28	$11.83	$1.69	373	$5.05
San Elizario					
2010	$0.00	$0.00	$0.00	0	$0.00
2020	$5.93	$0.00	$0.00	0	$1.85
2030	$15.13	$1.17	$0.12	26	$3.55
2040	$23.36	$5.50	$0.59	122	$4.91
2050	$36.43	$8.87	$0.94	197	$6.37
2060	$57.69	$12.24	$1.30	272	$7.82
Socorro					
2010	$0.00	$0.00	$0.00	0	$0.00
2020	$0.58	$0.00	$0.00	0	$1.00
2030	$1.47	$0.00	$0.00	0	$2.02
2040	$2.27	$0.00	$0.00	0	$2.78
2050	$10.60	$0.00	$0.00	0	$3.64
2060	$13.11	$0.00	$0.00	0	$4.50

Table 10: Economic Impacts of Water Shortages for Municipal Water User Groups ($millions)					
Decade	**Monetary value of domestic water shortages**	**Lost income from reduced commercial business activity**	**Lost state and local taxes from reduced commercial business activity**	**Lost jobs from reduced commercial business activity**	**Lost water utility revenues**
			Tornillo WCID		
2010	$0.00	$0.00	$0.00	0	$0.00
2020	$0.00	$0.00	$0.00	0	$0.00
2030	$0.00	$0.00	$0.00	0	$0.00
2040	$0.08	$0.00	$0.00	0	$0.12
2050	$0.26	$0.00	$0.00	0	$0.56
2060	$0.82	$0.00	$0.00	0	$1.00
			Vinton		
2010	$0.00	$0.00	$0.00	0	$0.00
2020	$2.12	$0.00	$0.00	0	$0.42
2030	$5.53	$0.00	$0.00	0	$0.79
2040	$7.22	$0.60	$0.09	19	$1.11
2050	$9.68	$0.93	$0.13	29	$1.44
2060	$11.81	$1.26	$0.18	40	$1.76
			Regional Totals		
2010	$0.00	$0.00	$0.00	0	$0.00
2020	$47.09	$0.00	$0.00	0	$7.66
2030	$118.70	$2.02	$0.25	53	$15.20
2040	$178.96	$14.08	$1.63	347	$21.54
2050	$284.64	$30.96	$3.49	739	$38.10
2060	$401.77	$48.82	$5.67	1,208	$62.55

[a] Changes to Income and business taxes are collectively equivalent to a decrease in gross state product, which is analogous to gross domestic product measured at the state rather than national level.

2.4 Impacts of Manufacturing Water Shortages

The Region E planning group estimates that manufacturers in El Paso County would be short about 800 acre-feet in 2020 (8 percent of projected manufacturing demands); and roughly 3,670 acre-feet (30 percent of projected demands) in 2060. The adverse impacts of these shortages would be substantial. In 2020, manufacturing water deficits would reduce gross state product by an estimated $456 million and threaten 1,450 jobs. By 2060, losses grow to nearly $1.7 billion with 6,572 jobs at stake (Table 11).

Table 11: Economic Impacts of Water Shortages for Manufacturing in El Paso County ($millions)			
Decade	Lost income due to reduced manufacturing output	Lost state and local business tax revenues due to reduced manufacturing output	Lost jobs due to reduced manufacturing output
2010	$0.00	$0.00	0
2020	$435.43	$21.73	1,454
2030	$809.28	$40.39	2,703
2040	$1,170.80	$58.43	3,910
2050	$1,478.23	$73.77	4,937
2060	$1,967.76	$98.20	6,572

[a] Changes to Income and business taxes are collectively equivalent to a decrease in gross state product, which is analogous to gross domestic product measured at the state rather than national level.

2.5 Impacts of Steam-electric Water Shortages

Water shortages for steam-electric water user groups are also projected to occur in El Paso County resulting in reduced income worth $286 million in 2020, and $772 million in 2060 (Table 12). Estimated jobs losses total 670 in 2020 and 1,809 in 2060.

Table 12: Economic Impacts of Water Shortages for Steam-electric Water User Groups in El Paso County ($millions)			
Decade	Lost income due to reduced electrical generation	Lost state and local business tax revenues due to reduced electrical generation	Lost jobs due to reduced electrical generation
2010	$0.00	$0.00	0
2020	$285.84	$27.24	670
2030	$374.02	$35.65	876
2040	$481.41	$45.88	1,128
2050	$612.32	$58.36	1,435
2060	$771.99	$73.58	1,809

[a] Changes to Income and business taxes are collectively equivalent to a decrease in gross state product, which is analogous to gross domestic product measured at the state rather than national level.

2.6 Social Impacts of Water Shortages

As discussed previously, estimated social impacts focus on changes in regional population and school enrollment. In 2010, estimated population losses total 409 with corresponding reductions in school enrollment of 115 students (Table 13). In 2060, population would decline by 11,750 people and school enrollment would fall by 2,173 students.

Table 13: Social Impacts of Water Shortages (2010-2060)

Year	Population Losses	Declines in School Enrollment
2010	409	115
2020	2,947	836
2030	4,745	1,257
2040	6,787	1,254
2050	8,814	1,628
2060	11,750	2,173

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Appendix: Economic Data for Individual IMPLAN Sectors for the Far West Texas Regional Water Planning Area

Economic Data for Agricultural Water User Groups ($millions)

Water Use Category	IMPLAN Sector	IMPLAN Code	Total Sales	Intermediate Sales	Final Sales	Jobs	Income	Business Taxes
Irrigation	Oilseed Farming	1	$0.01	$0	$0.06	1	$0.00	$0.00
Irrigation	Grain Farming	2	$0.95	$0.24	$0.71	43	$0.46	$0.02
Irrigation	Vegetable and Melon Farming	3	$39.79	$2.28	$34.25	427	$29.28	$0.36
Irrigation	Tree Nut Farming	4	$50.69	$39.71	$11.83	601	$35.12	$1.22
Irrigation	Fruit Farming	5	$9.89	$0.97	$8.76	158	$5.62	$0.22
Irrigation	Cotton Farming	8	$19.33	$0.14	$19.26	243	$7.11	$0.17
Irrigation	All “Other” Crop Farming	10	$20.44	$18.94	$1.80	221	$10.14	$0.39
Livestock	Cattle ranching and farming	11	$94.95	$65.84	$29.11	1,593	$7.50	$2.00
Livestock	Poultry and egg production	12	$1.90	$1.49	$0.41	15	$0.65	$0.01
Livestock	Animal production- except cattle and poultry	13	$4.75	$4.03	$0.72	305	$0.46	$0.07
Livestock	Dog and cat food manufacturing	46	$10.56	$1.02	$9.54	10	$1.47	$0.05
Livestock	Other animal food manufacturing	47	$25.32	$3.05	$22.26	37	$1.24	$0.09
Livestock	Fluid milk manufacturing	62	$139.01	$33.44	$105.57	240	$12.55	$0.81
	Total Agricultural	**NA**	$337.98	$108.38	$227.45	1,930	$134.84	$3.82

Based on year 2006 data from the Minnesota IMPLAN Group, Inc.

Economic Data for Mining and Steam-electric Water User Groups ($millions)

Water Use Category	IMPLAN Sector	IMPLAN Code	Total Sales	Intermediate Sales	Final Sales	Jobs	Income	Business Taxes
Mining	Oil and gas extraction	19	$121.59	$112.91	$8.67	150	$69.67	$7.64
Mining	Coal mining	20	$0.00	$0.00	$0.00	0	$0.00	$0.00
Mining	Iron ore mining	21	$0.00	$0.00	$0.00	0	$0.00	$0.00
Mining	Copper- nickel- lead- and zinc mining	22	$0.00	$0.00	$0.00	0	$0.00	$0.00
Mining	Gold- silver- and other metal ore mining	23	$0.00	$0.00	$0.00	0	$0.00	$0.00
Mining	Stone mining and quarrying	24	$1.00	$0.10	$0.89	5	$0.55	$0.01
Mining	Sand- gravel- clay- and refractory mining	25	$7.66	$0.81	$6.85	39	$4.51	$0.25
Mining	Other nonmetallic mineral mining	26	$13.11	$1.31	$11.80	76	$5.42	$0.31
Mining	Support activities for oil and gas operations	28	$7.50	$1.04	$6.46	41	$6.79	$0.32
Mining	Support activities for other mining	29	$0.23	$0.00	$0.23	2	$0.08	$0.01
Total Mining	NA		$184.65	$116.35	$68.30	$360.00	$98.28	$10.02
Steam-electric	Power generation and supply	30	$384.76	$108.24	$276.52	837	$267.12	$45.65

Based on year 2006 data from the Minnesota IMPLAN Group, Inc.

Economic Data for Manufacturing Water User Groups ($millions)

Water Use Category	IMPLAN Sector	IMPLAN Code	Total Sales	Intermediate Sales	Final Sales	Jobs	Income	Business Taxes
Manufacturing	Petroleum refineries	142	$3,795.98	$1,410.97	$2,385.01	322	$1,067.39	$40.63
Manufacturing	New residential 1-unit structures- all	33	$833.32	$0.00	$833.32	5,908	$252.93	$3.98
Manufacturing	Primary smelting and refining of copper	214	$560.08	$50.08	$510.00	160	$45.92	$5.87
Manufacturing	Commercial and institutional buildings	38	$452.88	$0.00	$452.88	5,150	$216.40	$2.67
Manufacturing	Motor vehicle parts manufacturing	350	$443.81	$35.69	$408.12	1,289	$86.33	$1.41
Manufacturing	Semiconductors and related device manufacturing	311	$429.72	$228.71	$201.01	547	$45.46	$1.28
Manufacturing	Iron and steel mills	203	$416.00	$29.97	$386.03	517	$70.72	$2.60
Manufacturing	Ready-mix concrete manufacturing	192	$368.74	$1.79	$366.95	787	$190.83	$5.63
Manufacturing	Copper wire- except mechanical- drawing	217	$342.76	$22.66	$320.10	381	$68.87	$3.25
Manufacturing	Soft drink and ice manufacturing	85	$267.58	$14.95	$252.64	434	$35.06	$1.55
Manufacturing	Household vacuum cleaner manufacturing	328	$233.91	$8.85	$225.06	867	$73.50	$1.65
Manufacturing	Plastics plumbing fixtures and all other plastics	177	$229.01	$165.90	$63.11	1,188	$83.98	$1.45
Manufacturing	Paperboard container manufacturing	126	$212.37	$2.25	$210.12	671	$55.43	$2.21
Manufacturing	Cut and sew apparel manufacturing	107	$202.21	$5.47	$196.74	1,409	$72.54	$1.17
Manufacturing	Other new construction	41	$196.41	$0.00	$196.41	2,363	$100.40	$0.79
Manufacturing	Electric housewares and household fan manufacturing	327	$185.41	$16.39	$169.01	456	$75.58	$2.06
Manufacturing	Footwear manufacturing	110	$171.76	$1.42	$170.34	1,230	$67.96	$1.56
Manufacturing	Natural gas distribution	31	$166.43	$66.71	$99.73	331	$37.68	$12.31
Manufacturing	Roasted nuts and peanut butter manufacturing	78	$152.57	$4.18	$148.39	337	$18.61	$0.69
Manufacturing	All other electronic component manufacturing	312	$141.25	$80.94	$60.31	669	$37.46	$0.64
Manufacturing	Lawn and garden equipment manufacturing	258	$140.95	$27.22	$113.73	328	$25.73	$0.79
Manufacturing	Soap and other detergent manufacturing	163	$137.76	$36.80	$100.96	120	$46.61	$1.32
Manufacturing	Ornamental and architectural metal work manufacturing	237	$118.25	$6.82	$111.42	779	$34.46	$0.51
Manufacturing	New residential additions and alterations-all	35	$117.01	$0.00	$117.01	703	$40.04	$0.57
Manufacturing	Hand and edge tool manufacturing	229	$98.25	$12.94	$85.31	399	$47.55	$0.68
Manufacturing	Copper rolling- drawing- and extruding	216	$97.11	$2.38	$94.73	142	$11.91	$0.61
Manufacturing	Highway- street- bridge- and tunnel construct	39	$97.09	$0.00	$97.09	997	$46.33	$0.59
Manufacturing	Other engine equipment manufacturing	286	$94.30	$56.13	$38.17	145	$12.74	$0.14

Based on year 2006 data from the Minnesota IMPLAN Group, Inc.

Economic Data for Manufacturing Water User Groups ($millions)

Water Use Category	IMPLAN Sector	IMPLAN Code	Total Sales	Intermediate Sales	Final Sales	Jobs	Income	Business Taxes
Manufacturing	Fruit and vegetable canning and drying	61	$90.82	$3.36	$87.46	221	$14.05	$0.44
Manufacturing	New multifamily housing structures- all	34	$88.49	$0.00	$88.49	858	$39.11	$0.23
Manufacturing	Plastics material and resin manufacturing	152	$76.90	$3.05	$73.85	46	$22.00	$0.69
Manufacturing	Water- sewer- and pipeline construction	40	$71.66	$0.00	$71.66	652	$29.73	$0.43
Manufacturing	Custom roll forming	226	$67.37	$1.87	$65.50	181	$13.95	$0.29
Manufacturing	Commercial printing	139	$66.25	$32.91	$33.33	858	$46.18	$0.58
Manufacturing	Other aluminum rolling and drawing	213	$65.03	$1.81	$63.22	93	$5.84	$0.21
Manufacturing	Ceramic wall and floor tile manufacturing	186	$62.88	$33.50	$29.38	311	$26.25	$0.73
Manufacturing	Miscellaneous nonmetallic mineral products	202	$57.49	$1.06	$56.43	170	$28.09	$0.63
Manufacturing	Fabricated structural metal manufacturing	233	$45.50	$2.36	$43.15	186	$15.02	$0.24
Manufacturing	Tortilla manufacturing	77	$44.84	$4.77	$40.07	295	$13.27	$0.30
Manufacturing	Electric lamp bulb and part manufacturing	325	$41.83	-$0.01	$41.84	186	$15.74	$0.28
Manufacturing	Metal valve manufacturing	248	$40.94	$4.43	$36.50	100	$22.33	$0.29
Manufacturing	All other forging and stamping	227	$40.68	$2.09	$38.59	197	$15.87	$0.23
Manufacturing	Broom- brush- and mop manufacturing	387	$40.50	$2.19	$38.31	183	$18.75	$0.25
Manufacturing	Plastics packaging materials- film and sheet	172	$39.79	$21.54	$18.24	140	$8.68	$0.24
Manufacturing	Other millwork- including flooring	119	$38.86	$30.18	$8.67	263	$7.38	$0.15
Manufacturing	Ferrous metal foundaries	221	$38.56	$0.04	$38.52	238	$10.59	$0.21
Manufacturing	Bread and bakery product- except frozen- manufacturing	73	$37.92	$8.47	$29.46	285	$13.84	$0.23
Manufacturing	Paint and coating manufacturing	161	$37.69	$0.48	$37.21	45	$14.03	$0.43
Manufacturing	Frozen food manufacturing	60	$36.07	$1.13	$34.94	144	$4.91	$0.14
Manufacturing	Narrow fabric mills and schiffli embroidery	94	$35.90	$1.39	$34.50	274	$14.39	$0.28
Manufacturing	Manufacturing and industrial buildings	37	$35.62	$0.00	$35.62	448	$18.00	$0.19
Manufacturing	Automobile and light truck manufacturing	344	$32.83	$0.04	$32.79	25	$1.09	$0.03
Manufacturing	Wood kitchen cabinet and countertop manufacturing	362	$32.62	$25.41	$7.21	312	$11.63	$0.19
Manufacturing	Plastics pipe- fittings- and profile shapes	173	$31.71	$19.50	$12.20	99	$6.92	$0.16
Manufacturing	Foam product manufacturing	178	$31.38	$23.89	$7.49	130	$8.56	$0.17
Manufacturing	Concrete block and brick manufacturing	193	$30.97	$0.13	$30.83	111	$12.67	$0.38

Based on year 2006 data from the Minnesota IMPLAN Group, Inc.

Economic Data for Manufacturing Water User Groups ($millions)

Water Use Category	IMPLAN Sector	IMPLAN Code	Total Sales	Intermediate Sales	Final Sales	Jobs	Income	Business Taxes
Manufacturing	Other snack food manufacturing	79	$30.15	$5.08	$25.07	42	$11.09	$0.28
Manufacturing	Surgical appliance and supplies manufacturing	376	$28.92	$7.22	$21.70	93	$14.93	$0.13
Manufacturing	Surgical and medical instrument manufacturing	375	$28.89	$9.78	$19.10	59	$16.52	$0.14
Manufacturing	Agriculture and forestry support activities	18	$28.01	$15.92	$12.09	1,204	$18.03	$0.24
Manufacturing	Asphalt shingle and coating materials manufacturing	144	$27.37	$14.76	$12.61	37	$8.58	$0.06
Manufacturing	Machine shops	243	$26.64	$6.43	$20.21	243	$9.53	$0.15
Manufacturing	Hunting and trapping	17	$24.67	$2.02	$22.65	128	$8.26	$1.61
Manufacturing	All other converted paper product manufacturing	135	$23.50	$0.27	$23.24	94	$7.63	$0.23
Manufacturing	Other computer peripheral equipment manufacturing	305	$23.42	$7.26	$16.15	56	$3.41	$0.09
Manufacturing	Other basic organic chemical manufacturing	151	$22.10	$4.12	$17.98	16	$5.71	$0.25
Manufacturing	Office furniture- except wood- manufacturing	370	$20.86	$0.19	$20.67	117	$11.80	$0.06
Manufacturing	Electronic computer manufacturing	302	$20.45	$4.76	$15.69	8	$1.02	$0.08
Manufacturing	Metal tank- heavy gauge- manufacturing	239	$19.73	$0.81	$18.92	70	$10.47	$0.14
Manufacturing	Rubber and plastics hose and belting manufacturing	180	$19.55	$0.49	$19.06	90	$7.39	$0.12
Manufacturing	Cut stone and stone product manufacturing	199	$19.36	$15.99	$3.37	111	$11.17	$0.22
Manufacturing	Electroplating- anodizing- and coloring metal	247	$19.18	$6.76	$12.41	106	$9.38	$0.11
Manufacturing	Aircraft manufacturing	351	$18.46	$0.94	$17.52	29	$6.14	$0.06
Manufacturing	Motor and generator manufacturing	334	$18.23	$1.73	$16.49	49	$8.43	$0.18
Manufacturing	Special tool- die- jig- and fixture manufacturing	282	$17.85	$10.23	$7.62	156	$7.10	$0.08
Manufacturing	Metal household furniture manufacturing	365	$17.81	$0.03	$17.78	124	$9.63	$0.06
Manufacturing	Meat processed from carcasses	68	$17.27	$5.09	$12.17	41	$1.35	$0.07
Manufacturing	AC- refrigeration- and forced air heating	278	$17.04	$0.00	$17.04	60	$2.36	$0.06
Manufacturing	Wood container and pallet manufacturing	120	$16.12	$10.72	$5.40	164	$4.51	$0.07
Manufacturing	Miscellaneous fabricated metal product manufacturing	255	$15.77	$0.08	$15.69	50	$8.67	$0.14
Manufacturing	Textile and fabric finishing mills	97	$15.18	$6.41	$8.77	65	$2.99	$0.09
Manufacturing	Jewelry and silverware manufacturing	380	$15.13	$0.31	$14.83	58	$5.20	$0.08
Manufacturing	Watch- clock- and other measuring and control	321	$14.71	$1.42	$13.30	66	$1.76	$0.03
Manufacturing	Plate work manufacturing	234	$14.24	$0.90	$13.35	72	$4.43	$0.06

Based on year 2006 data from the Minnesota IMPLAN Group, Inc.

Economic Data for Manufacturing Water User Groups ($millions)

Water Use Category	IMPLAN Sector	IMPLAN Code	Total Sales	Intermediate Sales	Final Sales	Jobs	Income	Business Taxes
Manufacturing	Spring and wire product manufacturing	242	$12.97	$1.38	$11.58	75	$4.27	$0.07
Manufacturing	Sign manufacturing	384	$12.77	$4.14	$8.64	109	$6.88	$0.08
Manufacturing	Turned product and screw- nut- and bolt manufacturing	244	$12.61	$2.60	$10.01	88	$4.38	$0.05
Manufacturing	Search- detection- and navigation instruments	314	$11.96	$3.97	$7.99	40	$3.15	$0.04
Manufacturing	Adhesive manufacturing	162	$11.84	$9.11	$2.73	17	$4.79	$0.12
Manufacturing	Scales- balances- and miscellaneous general p	301	$11.41	$2.46	$8.95	46	$3.48	$0.06
Manufacturing	Accessories and other apparel manufacturing	108	$11.32	$0.79	$10.53	71	$5.44	$0.08
Manufacturing	Textile bag and canvas mills	101	$10.88	$0.12	$10.75	94	$2.17	$0.03
Manufacturing	Secondary smelting and alloying of aluminum	210	$10.68	$0.17	$10.51	15	$0.87	$0.04
Manufacturing	All other food manufacturing	84	$8.74	$0.74	$8.00	37	$1.01	$0.03
Manufacturing	Wood windows and door manufacturing	117	$8.60	$7.83	$0.77	60	$2.81	$0.04
Manufacturing	Nonupholstered wood household furniture manufacturing	364	$7.91	$0.23	$7.68	80	$2.59	$0.02
Manufacturing	Logging	14	$1.76	$1.31	$0.44	7	$0.47	$0.02
Manufacturing	Mattress manufacturing	372	$7.38	$0.01	$7.37	35	$2.28	$0.02
Manufacturing	Pharmaceutical and medicine manufacturing	160	$7.14	$1.30	$5.83	8	$1.85	$0.04
Manufacturing	Other leather product manufacturing	111	$7.11	$1.12	$5.99	49	$3.11	$0.06
Manufacturing	Other communication and energy wire manufacturing	340	$7.09	$3.32	$3.77	15	$2.62	$0.08
Manufacturing	Engineered wood member and truss manufacturing	116	$7.00	$6.57	$0.43	54	$2.40	$0.03
Manufacturing	Other major household appliance manufacturing	332	$6.92	$0.42	$6.50	20	$1.46	$0.04
Manufacturing	Toilet preparation manufacturing	166	$6.84	$0.74	$6.10	8	$2.80	$0.02
Manufacturing	Cutting tool and machine tool accessory manufacturing	283	$6.79	$4.73	$2.06	50	$2.41	$0.03
Manufacturing	Electric power and specialty transformers	333	$6.60	$3.49	$3.12	26	$2.14	$0.05
Manufacturing	All other industrial machinery manufacturing	269	$6.37	$1.62	$4.75	34	$1.26	$0.01
Manufacturing	Custom compounding of purchased resins	169	$5.50	$5.25	$0.25	9	$2.25	$0.02
Manufacturing	Sheet metal work manufacturing	236	$5.24	$0.29	$4.96	33	$1.74	$0.02
Manufacturing	Other miscellaneous chemical products	171	$5.23	$2.74	$2.50	7	$2.33	$0.07
Manufacturing	Custom architectural woodwork and millwork	369	$5.21	$4.58	$0.62	52	$2.94	$0.01
Manufacturing	All other manufacturing	NA	$104.89	$20.14	$84.75	556	$34.88	$0.60

Based on year 2006 data from the Minnesota IMPLAN Group, Inc.

Economic Data for Municipal Water User Groups ($millions)

Water Use Category	IMPLAN Sector	IMPLAN Code	Total Sales	Intermediate Sales	Final Sales	Jobs	Income	Business Taxes
Municipal	Lessors of nonfinancial intangible assets	436	$16,164.50	$8,815.05	$7,349.45	470	$7,581.26	$744.98
Municipal	Real estate	431	$4,377.11	$1,732.70	$2,644.42	27,461	$2,529.79	$542.02
Municipal	Wholesale trade	390	$1,834.11	$878.11	$956.01	13,132	$965.13	$271.77
Municipal	Owner-occupied dwellings	509	$1,776.08	$0.00	$1,776.08	0	$1,375.87	$210.01
Municipal	State & Local Education	503	$1,662.99	$0.00	$1,662.99	40,669	$1,662.99	$0.00
Municipal	Federal Military	505	$1,323.79	$0.00	$1,323.79	12,576	$1,323.78	$0.00
Municipal	Federal Non-Military	506	$1,170.87	$0.00	$1,170.87	7,660	$1,170.87	$0.00
Municipal	Food services and drinking places	481	$1,129.62	$144.25	$985.36	25,025	$439.36	$51.39
Municipal	Truck transportation	394	$1,103.99	$597.78	$506.21	9,133	$474.22	$10.78
Municipal	Telecommunications	422	$850.60	$292.17	$558.44	2,417	$349.02	$58.07
Municipal	Offices of physicians- dentists- and other he	465	$846.47	$0.00	$846.47	7,077	$601.41	$5.29
Municipal	Hospitals	467	$753.57	$0.00	$753.56	6,528	$403.89	$5.16
Municipal	State & Local Non-Education	504	$734.91	$0.00	$734.91	11,882	$734.91	$0.00
Municipal	Motor vehicle and parts dealers	401	$577.61	$62.81	$514.80	5,722	$296.26	$84.15
Municipal	Monetary authorities and depository credit in	430	$566.34	$186.53	$379.81	3,044	$397.69	$7.25
Municipal	General merchandise stores	410	$459.91	$48.47	$411.43	9,013	$201.74	$64.18
Municipal	Business support services	455	$425.06	$198.93	$226.13	7,484	$231.11	$8.78
Municipal	Other State and local government enterprises	499	$387.33	$126.13	$261.20	1,831	$143.84	$0.05
Municipal	Home health care services	464	$347.16	$0.00	$347.16	9,538	$212.39	$1.25
Municipal	Insurance carriers	427	$337.50	$98.41	$239.09	1,634	$93.38	$11.58
Municipal	All other miscellaneous professional and tech	450	$329.52	$294.20	$35.32	1,193	$45.59	$0.92
Municipal	Other ambulatory health care services	466	$283.92	$18.47	$265.45	1,867	$143.91	$2.15
Municipal	Rail transportation	392	$279.25	$135.01	$144.23	809	$170.40	$5.40
Municipal	Social assistance- except child day care serv	470	$266.25	$0.05	$266.20	10,047	$119.83	$0.83
Municipal	Food and beverage stores	405	$265.89	$35.55	$230.34	4,999	$132.91	$29.20
Municipal	Clothing and clothing accessories stores	408	$253.87	$31.79	$222.08	5,047	$130.06	$36.93
Municipal	Legal services	437	$247.26	$156.93	$90.34	2,240	$152.43	$4.76

Based on year 2006 data from the Minnesota IMPLAN Group, Inc.

Economic Data for Municipal Water User Groups ($millions)

Water Use Category	IMPLAN Sector	IMPLAN Code	Total Sales	Intermediate Sales	Final Sales	Jobs	Income	Business Taxes
Municipal	Automotive equipment rental and leasing	432	$235.34	$96.25	$139.10	1,523	$85.87	$4.31
Municipal	Architectural and engineering services	439	$233.24	$147.03	$86.21	2,134	$116.22	$0.97
Municipal	Building material and garden supply stores	404	$231.70	$35.93	$195.77	2,696	$109.45	$33.26
Municipal	Scenic and sightseeing transportation and sup	397	$208.96	$78.39	$130.56	1,803	$141.75	$24.24
Municipal	Employment services	454	$202.34	$167.46	$34.88	9,684	$166.60	$0.95
Municipal	Automotive repair and maintenance- except car	483	$193.71	$46.01	$147.70	2,815	$66.93	$13.32
Municipal	Insurance agencies- brokerages- and related	428	$189.17	$111.01	$78.16	1,831	$160.44	$1.01
Municipal	Nondepository credit intermediation and rela	425	$186.53	$114.19	$72.34	1,767	$98.65	$7.55
Municipal	Gasoline stations	407	$176.43	$26.80	$149.64	2,626	$95.32	$25.41
Municipal	Nonstore retailers	412	$175.49	$27.11	$148.38	4,596	$110.49	$19.84
Municipal	Health and personal care stores	406	$169.85	$27.11	$142.74	2,613	$83.57	$24.32
Municipal	Hotels and motels- including casino hotels	479	$161.99	$83.45	$78.54	2,801	$86.63	$14.85
Municipal	Accounting and bookkeeping services	438	$160.87	$130.64	$30.23	2,162	$69.49	$0.56
Municipal	Maintenance and repair of nonresidential buil	43	$148.27	$98.24	$50.03	1,321	$53.28	$0.99
Municipal	Civic- social- professional and similar organ	493	$148.16	$52.06	$96.10	4,485	$70.66	$0.45
Municipal	Nursing and residential care facilities	468	$144.05	$0.00	$144.05	2,921	$91.74	$2.18
Municipal	Other educational services	463	$139.05	$11.74	$127.31	2,550	$75.52	$4.29
Municipal	Grantmaking and giving and social advocacy or	492	$132.70	$0.00	$132.70	3,247	$44.41	$0.23
Municipal	Office administrative services	452	$123.32	$54.86	$68.46	793	$64.10	$1.10
Municipal	Pipeline transportation	396	$121.86	$53.29	$68.56	24	$59.37	$12.94
Municipal	Securities- commodity contracts- investments	426	$117.77	$78.21	$39.56	968	$43.33	$1.28
Municipal	Services to buildings and dwellings	458	$117.67	$86.82	$30.85	2,634	$49.37	$1.77
Municipal	Radio and television broadcasting	420	$111.52	$88.53	$22.99	610	$36.16	$0.46
Municipal	Air transportation	391	$109.29	$12.17	$97.12	519	$28.79	$3.67
Municipal	Furniture and home furnishings stores	402	$105.25	$16.09	$89.16	1,391	$50.70	$14.95
Municipal	Miscellaneous store retailers	411	$105.07	$13.04	$92.03	3,045	$63.60	$15.29

Based on year 2006 data from the Minnesota IMPLAN Group, Inc.

Economic Data for Municipal Water User Groups ($millions)

Water Use Category	IMPLAN Sector	IMPLAN Code	Total Sales	Intermediate Sales	Final Sales	Jobs	Income	Business Taxes
Municipal	Postal service	398	$104.28	$71.00	$33.29	1,614	$82.48	$0.00
Municipal	Management of companies and enterprises	451	$97.58	$91.76	$5.81	688	$46.15	$0.74
Municipal	State and local government electric utilities	498	$92.43	$24.97	$67.46	252	$46.58	$0.24
Municipal	Management consulting services	444	$87.14	$67.08	$20.06	809	$37.47	$0.29
Municipal	Couriers and messengers	399	$84.33	$76.67	$7.66	998	$55.47	$1.29
Municipal	Other maintenance and repair construction	45	$80.87	$28.19	$52.68	1,375	$48.94	$0.47
Municipal	Investigation and security services	457	$80.78	$51.66	$29.13	2,558	$54.34	$1.28
Municipal	Data processing services	424	$80.65	$16.55	$64.10	479	$34.21	$0.44
Municipal	Advertising and related services	447	$80.00	$74.58	$5.42	632	$33.56	$0.56
Municipal	Child day care services	469	$77.03	$0.00	$77.03	2,981	$43.08	$0.51
Municipal	Waste management and remediation services	460	$75.07	$42.20	$32.88	481	$34.77	$2.76
Municipal	Scientific research and development services	446	$75.05	$57.67	$17.38	638	$38.15	$0.31
Municipal	All other municipal		$1,479.99	$459.64	$1,020.35	26,862	$721.51	$45.51

Based on year 2006 data from the Minnesota IMPLAN Group, Inc.

APPENDIX 4B

ADDITIONAL STRATEGIES FOR

FUTURE CONSIDERATION

ADDITIONAL STRATEGIES FOR FUTURE CONSIDERATION

Tri-County Water Supply Proposal

The Tri-County Coalition (El Paso, Hudspeth and Culberson Counties) is evaluating the feasibility of a regional water treatment, storage, and distribution facility. Funding for the evaluation is under the auspices of the Hudspeth County Conservation and Reclamation District No. 1. The preliminary feasibility study is considering the following components to the proposed plan:

- 45 MGD (50,000 acre-foot per year) water treatment plant
- Pre-treatment and desalination
- Off-channel 30,000 acre-foot settling and storage reservoir
- Water supplied primarily by irrigation district canals
- Secondary supply by hydrograph trimming of flood flows
- Drought contingency supply from Dell City or ASR
- Brine disposal by deep well injection or evaporation ponds
- Primary facilities located upstream of Ft, Quitman
- 60 miles of 48" diameter treated water transmission line
- ROW availability from U.S. or from irrigation districts

CHAPTER 5

WATER QUALITY IMPACTS AND IMPACTS ON MOVING WATER FROM AGRICULTURAL AREAS

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5.1 INTRODUCTION

Water quality plays an important role in determining the availability of water supplies to meet current and future water needs in the Region. This chapter describes the general water quality of the groundwater and surface water sources in Far West Texas, discusses specific water quality issues, details potential impacts resulting from the implementation of water management strategies, and the potential impacts of moving water from agricultural areas. Primary and secondary safe drinking water standards are the key parameters of water quality identified by the Far West Texas Water Planning Group (FWTWPG) as important to the use of the water resource (Table 5-1).

A groundwater quality database using water quality analyses from the TWDB groundwater database was established for the primary aquifers in the Region. Tables 5-2 through 5-8 provide information pertaining to the number of mineral constituent analyses available and the percent of these analyses that depict concentration levels above safe drinking water standards.

While there appears to be a sufficient number of evenly distributed sample locations (Figure 5-1) for making regional quality assumptions, many of the sample dates are relatively old and thus less reliable as current indicators. It is recommended that these older analyses be replaced by re-sampling the same wells or, if not available, new wells in the same general area. Additional analyses are needed for the southern portion of the Davis Mountains Igneous Aquifer in Presidio County and the Marathon Aquifer in Brewster County. Groundwater conservations districts should take the lead in this task within their respective areas.

5.2 WATER QUALITY STANDARDS

Screening levels for public drinking water supplies were used for comparisons of water quality data in the region. Drinking water standards are classified as primary and secondary and are listed in terms of maximum contaminant levels (MCLs) as defined in the Texas Administrative Code (30 TAC, Chapter 290, Subchapter F). U.S. Environmental Protection Agency (EPA) MCLs for certain secondary constituents are more stringent than the State standards.

Primary MCLs are legally enforceable standards that apply to public drinking water supplies in order to protect human health from contaminants in drinking water. Secondary standards are non-enforceable guidelines based on aesthetic effects that these constituents may cause (taste, color, odor, etc.). In addition to primary MCLs and secondary standards, two constituents, lead and copper, have action levels specified. These action levels apply to community and non-transient non-community water systems, and to new water systems when notified by the Texas Commission on Environmental Quality (TCEQ) Executive Director. A summary of the public drinking water supply parameters used to evaluate water quality is provided in Table 5-1. Certain constituents on the State list are not included on the table because there is a significant lack of analyses containing these elements in the public databases that were used.

On October 31, 2001, the U.S. Environmental Protection Agency (EPA) announced that the new arsenic maximum contaminant level (MCL) for drinking water is lowered from 50 to 10 parts per billion (ppb) with a compliance date of January 23, 2006. Because of this impending new standard, a screening level of 10 ppb is used for this evaluation.

Table 5-1. Selected Public Drinking Water Supply Parameters

Constituent	Maximum Contaminant Level (mg/l unless otherwise noted)	Type of Standard
Nitrate-N	10	Primary
Fluoride	4	Primary
Barium	2	Primary
Alpha	15 pc/L	Primary
Cadmium	0.005	Primary
Chromium	0.1	Primary
Selenium	0.05	Primary
Arsenic	0.01	Primary
Lead	0.015	Action Level
Copper	1.3	Action Level
TDS	1000	Secondary
Chloride	300	Secondary
Sulfate	300	Secondary
pH	6.5 – 8.5	Secondary
Fluoride	2	Secondary
Iron	0.3	Secondary
Manganese	0.05	Secondary
Copper	1	Secondary

Primary drinking water standard from 30 TAC Chapter 290, Subchapter F, Rule 290.106

Action Level for Copper and Lead from 30 TAC Chapter 290, Subchapter F, Rule 290.117

Secondary drinking water standard from 30 TAC Chapter 290 Subchapter F, Rule 290.118

5.3 GROUNDWATER QUALITY

All groundwater contains minerals carried in solution and their concentration is rarely uniform throughout the extent of an aquifer. The degree and type of mineralization of groundwater determines its suitability for municipal, industrial, irrigation and other uses. Groundwater resources in Far West Texas vary from potable to nonpotable, often within the same aquifer. 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 quality of groundwater in the aquifers within the Region was evaluated to help determine the suitability of groundwater sources for use and the potential impacts on these sources that might result from the implementation of recommended water management strategies. Water-quality data was compiled from the TWDB groundwater database and the TCEQ public water-supply well database.

TDS is commonly used to generally define groundwater quality. TDS refers to the sum of the concentrations of all of the dissolved ions in groundwater, which are chiefly composed of sodium, calcium, magnesium, potassium, chloride, sulfate, and bicarbonate ions. The TWDB has defined gross aquifer water quality in terms of TDS concentrations expressed in milligrams per liter (mg/l), and has classified water into four broad categories:

- fresh (less than 1,000 mg/l);
- slightly saline (1,000 - 3,000 mg/l);
- moderately saline (3,000 - 10,000 mg/l); and
- saline (10,000 - 35,000 mg/l).

Because of its usefulness as an indicator of general groundwater quality, TDS served as a primary parameter of interest for this evaluation. Figure 5-1 shows the TDS of groundwater samples from across the Region. As can be seen in this figure, a large amount of groundwater throughout the region is slightly to moderately saline, including most or all of the Rustler and Bone Spring-Victorio Peak Aquifers and parts of the Hueco and Mesilla Bolsons, the Rio Grande Alluvium, and the Capitan Reef Aquifers.

5.3.1 Hueco Bolson Aquifer

The quality of Hueco Bolson groundwater differs according to location and depth, with the freshest water occurring at shallower depths along the eastern front of the Franklin Mountains and extending a short distance into Mexico. Outward from the mountain front and at deeper depths, the aquifer contains groundwater of slightly saline quality. Likewise, the overlying Rio Grande Alluvium contains slightly to moderately saline groundwater.

As indicated in Table 5-2, water quality in the Hueco Bolson Aquifer contains low numbers of detections of primary contaminants above screening levels. Arsenic is detected above the 10 ppb (0.01 mg/l) screening level in 24 percent of the samples. Several other parameters with primary standards are detected above the MCL, but they represent only 2 percent or lower of the samples. Of the secondary drinking water standards, all of the parameters except copper exceed standard limits in some of the results.

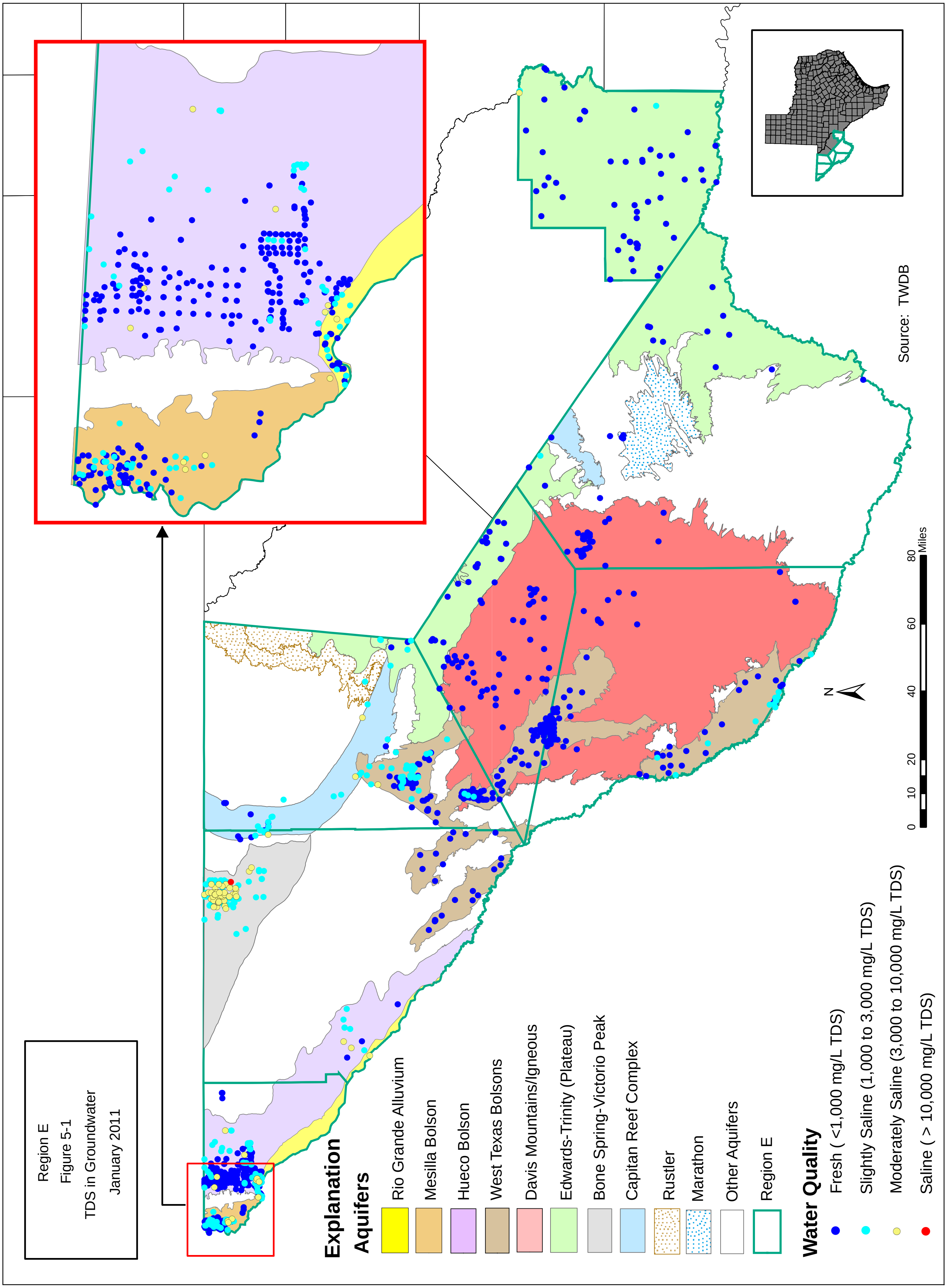

FIGURE 5-1. TOTAL DISSOLVED SOLIDS IN GROUNDWATER IN THE FAR WEST TEXAS REGION

Pumping primarily for municipal use has negatively impacted water quality in the Hueco Bolson. As the fresh water portion of the aquifer has been extracted over time, brackish quality water has migrated inward toward the pumping centers. The placement of wells to supply brackish groundwater to the new joint desalination facility is positioned to capture the poorer quality water before it can encroach into the fresh water zones.

Table 5-2. Occurrence and Levels of Selected Public Drinking Water Supply Parameters in the Hueco Bolson Aquifer

Constituent	Number of Results	Screening Level (mg/l unless otherwise noted)	Type of Standard	Percent of Results Exceeding Screening Level
Nitrate-N	414	10	Primary	2%
Fluoride	453	4	Primary	1%
Barium	195	2	Primary	1%
Cadmium	141	0.005	Primary	1%
Chromium	173	0.1	Primary	1%
Selenium	159	0.05	Primary	1%
Arsenic	186	0.01	Primary	24%
Lead	165	0.015	Action Level	2%
Copper	160	1.3	Action Level	0%
TDS	483	1000	Secondary	32%
Chloride	483	300	Secondary	36%
Sulfate	483	300	Secondary	20%
pH	470	6.5 – 8.5	Secondary	4%
Fluoride	556	2	Secondary	5%
Iron	320	0.3	Secondary	12%
Manganese	268	0.05	Secondary	18%
Copper	160	1	Secondary	0%

Primary- Primary drinking water standard (maximum contaminant level) from 30 TAC Chapter 290 Subchapter F

Action Level- Copper and Lead have action levels as defined by 30 TAC 290.117

Secondary- Secondary drinking water standard from 30 TAC Chapter 290 Subchapter F

5.3.2 Mesilla Bolson Aquifer

Only a small portion of the Mesilla Bolson occurs in Texas. Of that part, the freshest water is found in the deeper zones of the Bolson in and near the El Paso Water Utility's Canutillo well field. Water quality becomes increasingly brackish in shallower zones and is saline in the southernmost extent of the aquifer in Texas. Of particular concern is the occurrence of arsenic in Mesilla Bolson water. Table 5-3 shows that 59 percent of 27 sample analyses report arsenic levels above the MCL. Secondary standards are also exceeded in a number of the samples.

Table 5-3. Occurrence and Levels of Selected Public Drinking Water Supply Parameters in the Mesilla Bolson Aquifer

Constituent	Number of Results	Screening Level (mg/l unless otherwise noted)	Type of Standard	Percent of Results Exceeding Screening Level
Nitrate-N	96	10	Primary	0%
Fluoride	100	4	Primary	2%
Barium	25	2	Primary	0%
Cadmium	25	0.005	Primary	0%
Chromium	25	0.1	Primary	0%
Selenium	25	0.05	Primary	0%
Arsenic	27	0.01	Primary	59%
Lead	27	0.015	Action Level	0%
Copper	24	1.3	Action Level	0%
TDS	102	1000	Secondary	28%
Chloride	102	300	Secondary	30%
Sulfate	102	300	Secondary	22%
pH	101	6.5 – 8.5	Secondary	21%
Fluoride	100	2	Secondary	12%
Iron	27	0.3	Secondary	21%
Manganese	41	0.05	Secondary	17%
Copper	24	1	Secondary	0%

Primary- Primary drinking water standard (maximum contaminant level) from 30 TAC Chapter 290 Subchapter F

Action Level- Copper and Lead have action levels as defined by 30 TAC 290.117

Secondary- Secondary drinking water standard from 30 TAC Chapter 290 Subchapter F

5.3.3 Bone Spring-Victorio Peak Aquifer

Groundwater of the Bone Spring-Victorio Peak Aquifer is slightly saline to moderately saline. Total dissolved solids range from approximately 1,000 to more than 6,500 mg/l. The average is about 3,500 mg/l. The highest concentrations occur along the eastern half of the valley, where concentrations exceed 5,000 mg/l.

Both nitrate (20 percent of the results) and alpha radiation (44 percent) are detected above the primary MCL in the Bone Spring-Victorio Peak Aquifer (Table 5-4). None of the other parameters with primary standards are detected above the screening level. Nearly all of the secondary drinking water standards are detected above the screening levels, including TDS and chloride in all of the results, and sulfate in 82 percent of the results.

Table 5-4. Occurrence and Levels of Selected Public Drinking Water Supply Parameters in the Bone Spring-Victorio Peak Aquifer

Constituent	Number of Results	Screening Level (mg/l unless otherwise noted)	Type of Standard	Percent of Results Exceeding Screening Level
Nitrate-N	102	10	Primary	20%
Fluoride	97	4	Primary	0%
Barium	41	2	Primary	0%
Alpha	25	15 pc/L	Primary	44%
Cadmium	18	0.005	Primary	0%
Chromium	19	0.1	Primary	0%
Selenium	38	0.05	Primary	0%
Arsenic	34	0.01	Primary	0%
Lead	18	0.015	Action Level	0%
Copper	37	1.3	Action Level	0%
TDS	107	1000	Secondary	100%
Chloride	107	300	Secondary	100%
Sulfate	107	300	Secondary	82%
pH	102	6.5 – 8.5	Secondary	1%
Fluoride	97	2	Secondary	36%
Iron	42	0.3	Secondary	7%
Manganese	39	0.05	Secondary	3%
Copper	37	1	Secondary	0%

Primary- Primary drinking water standard (maximum contaminant level) from 30 TAC Chapter 290 Subchapter F

Action Level- Copper and Lead have action levels as defined by 30 TAC 290.117

Secondary- Secondary drinking water standard from 30 TAC Chapter 290 Subchapter F

5.3.4 Davis Mountains Igneous Aquifer

Groundwater from the Davis Mountains Igneous Aquifer is of excellent quality. Total dissolved solids are generally within the range of 300 to 500 mg/l, but elevated levels of fluoride, a common constituent of igneous rocks, are common.

The only parameters with detections above the primary MCL in the aquifer are nitrate (3 percent of the results) and alpha radiation (6 percent) (Table 5-5). Of the secondary drinking water standards, only fluoride (27 percent), iron (9 percent), manganese (4 percent), and pH (1 percent) were detected above the screening levels.

Table 5-5. Occurrence and Levels of Selected Public Drinking Water Supply Parameters in the Davis Mountains Igneous Aquifer

Constituent	Number of Results	Screening Level (mg/l unless otherwise noted)	Type of Standard	Percent of Results Exceeding Screening Level
Nitrate-N	118	10	Primary	3%
Fluoride	118	4	Primary	0%
Barium	28	2	Primary	0%
Alpha	16	15 pc/L	Primary	6%
Cadmium	26	0.005	Primary	0%
Chromium	26	0.1	Primary	0%
Selenium	27	0.05	Primary	0%
Arsenic	26	0.01	Primary	0%
Lead	26	0.015	Action Level	0%
Copper	26	1.3	Action Level	0%
TDS	120	1000	Secondary	0%
Chloride	121	300	Secondary	0%
Sulfate	121	300	Secondary	0%
pH	117	6.5 – 8.5	Secondary	1%
Fluoride	118	2	Secondary	27%
Iron	43	0.3	Secondary	9%
Manganese	23	0.05	Secondary	4%
Copper	26	1	Secondary	0%

Primary- Primary drinking water standard (maximum contaminant level) from 30 TAC Chapter 290 Subchapter F
Action Level- Copper and Lead have action levels as defined by 30 TAC 290.117
Secondary- Secondary drinking water standard from 30 TAC Chapter 290 Subchapter F

5.3.5 West Texas Bolsons Aquifer

The parameters with detections above the primary MCL in the West Texas Bolsons Aquifer include nitrate (74 percent of the results), arsenic (16 percent), fluoride (7 percent) and alpha radiation (5 percent) (Table 5-6). Most of the secondary drinking water standards were detected above screening levels in some results, including TDS (20 percent), sulfate (19 percent), chloride (19 percent).

Table 5-6. Occurrence and Levels of Selected Public Drinking Water Supply Parameters in the West Texas Bolsons Aquifer

Constituent	Number of Results	Screening Level (mg/l unless otherwise noted)	Type of Standard	Percent of Results Exceeding Screening Level
Nitrate-N	238	10	Primary	74%
Fluoride	206	4	Primary	7%
Barium	74	2	Primary	0%
Alpha	60	15 pc/L	Primary	5%
Cadmium	57	0.005	Primary	0%
Chromium	70	0.1	Primary	0%
Selenium	75	0.05	Primary	0%
Arsenic	68	0.01	Primary	16%
Lead	57	0.015	Action Level	0%
Copper	68	1.3	Action Level	0%
TDS	249	1000	Secondary	20%
Chloride	248	300	Secondary	19%
Sulfate	248	300	Secondary	19%
pH	243	6.5 – 8.5	Secondary	7%
Fluoride	206	2	Secondary	31%
Iron	97	0.3	Secondary	5%
Manganese	88	0.05	Secondary	0%
Copper	68	1	Secondary	0%

Primary- Primary drinking water standard (maximum contaminant level) from 30 TAC Chapter 290 Subchapter F
Action Level- Copper and Lead have action levels as defined by 30 TAC 290.117
Secondary- Secondary drinking water standard from 30 TAC Chapter 290 Subchapter F

5.3.6 Capitan Reef Aquifer

The only parameters with detections above the primary MCL in the Capitan Reef Aquifer were nitrate (3 percent of the results) and alpha radiation (8 percent) (Table 5-7). Most of the secondary drinking water standards were detected above the screening level, including TDS (62 percent), sulfate (77 percent), chloride (20 percent), fluoride (19 percent), iron (40 percent), manganese (33 percent), and pH (9 percent).

Table 5-7. Occurrence and Levels of Selected Public Drinking Water Supply Parameters in the Capitan Reef Aquifer

Constituent	Number of Results	Screening Level (mg/l unless otherwise noted)	Type of Standard	Percent of Results Exceeding Screening Level
Nitrate-N	31	10	Primary	3%
Fluoride	31	4	Primary	0%
Barium	18	2	Primary	0%
Alpha	12	15 pc/L	Primary	8%
Cadmium	17	0.005	Primary	0%
Chromium	17	0.1	Primary	0%
Selenium	17	0.05	Primary	0%
Arsenic	17	0.01	Primary	0%
Lead	17	0.015	Action Level	0%
Copper	17	1.3	Action Level	0%
TDS	34	1000	Secondary	62%
Chloride	35	300	Secondary	20%
Sulfate	35	300	Secondary	77%
pH	32	6.5 – 8.5	Secondary	9%
Fluoride	31	2	Secondary	19%
Iron	20	0.3	Secondary	40%
Manganese	18	0.05	Secondary	33%
Copper	17	1	Secondary	0%

Primary- Primary drinking water standard (maximum contaminant level) from 30 TAC Chapter 290 Subchapter F
Action Level- Copper and Lead have action levels as defined by 30 TAC 290.117
Secondary- Secondary drinking water standard from 30 TAC Chapter 290 Subchapter F

5.3.7 Edwards-Trinity (Plateau) Aquifer

Water quality in the Edwards-Trinity (Plateau) Aquifer is generally good, with most of the water produced from wells being fresh, with only a few parameters being detected above screening levels (Table 5-8). Of the primary maximum contaminant levels, only alpha radiation (9 percent of the results) and arsenic (2 percent) were above the primary MCL. Most of the secondary drinking water standards were detected in some of the results above the screening level, including TDS (11 percent of the results), sulfate (14 percent), chloride (10 percent), fluoride (15 percent), iron (12 percent), and manganese (2 percent).

Table 5-8. Occurrence and Levels of Selected Public Drinking Water Supply Parameters in the Edwards-Trinity (Plateau) Aquifer

Constituent	Number of Results	Screening Level (mg/l unless otherwise noted)	Type of Standard	Percent of Results Exceeding Screening Level
Nitrate-N	79	10	Primary	0%
Fluoride	79	4	Primary	0%
Barium	58	2	Primary	0%
Alpha	43	15 pc/L	Primary	9%
Cadmium	44	0.005	Primary	0%
Chromium	44	0.1	Primary	0%
Selenium	45	0.05	Primary	0%
Arsenic	57	0.01	Primary	2%
Lead	57	0.015	Action Level	0%
Copper	57	1.3	Action Level	0%
TDS	79	1000	Secondary	11%
Chloride	82	300	Secondary	10%
Sulfate	81	300	Secondary	14%
pH	82	6.5 – 8.5	Secondary	0%
Fluoride	79	2	Secondary	15%
Iron	60	0.3	Secondary	12%
Manganese	59	0.05	Secondary	2%
Copper	57	1	Secondary	0%

Primary- Primary drinking water standard (maximum contaminant level) from 30 TAC Chapter 290 Subchapter F

Action Level- Copper and Lead have action levels as defined by 30 TAC 290.117

Secondary- Secondary drinking water standard from 30 TAC Chapter 290 Subchapter F

5.4 SURFACE WATER QUALITY

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. Surface water, as it occurs on the land surface, is also more susceptible to biological and petrochemical contamination. Treatment cost to prepare surface water for municipal distribution is generally much greater than cost for groundwater sources, although desalination of brackish groundwater may be similar.

5.4.1 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. A 1996 TNRCC inventory of water quality in the state 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.

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.

Increasing water salinity has a negative impact on agriculture. The amount of impact depends on the amount of salinity and amount of sodium in a given water source. With respect to animal agriculture, increased salinity of drinking water creates additional stress on animals, particularly young or lactating animals. As irrigation water salinity increases, potential crop yields decrease. Salt buildup in soils can have a long-term detrimental effect. Most crop production practices in El Paso County have been modified to deal with the use of saline irrigation water. If salinity levels increase, the mixture of crops grown may change to reflect crops with greater tolerance to soil salinity. Unfortunately, many of those salt tolerant crops are not high value crops. Elevated concentrations of chloride and sulfate in the Rio Grande should only be considered indicators of elevated irrigation water salinity. Since very little sprinkler irrigation takes place in the valley, chloride should have less impact on agriculture.

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.

5.4.2 Pecos River Water Quality

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. Concentrations of chloride, sulfate, and total dissolved solids are significantly higher in the Pecos in the counties upstream of its traverse along Terrell County. Natural contributions of salts from the soil, as well as numerous saline groundwater seeps and springs, contribute to the high concentration of dissolved solids. 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. Salinity in the Pecos River is currently being studied by Texas A&M.

5.5 Current Water Quality Issues

Within Far West Texas, several specific water quality issues should be mentioned, including the presence of arsenic and alpha radiation in some groundwater supplies, water quality deterioration in the Bone Spring-Victorio Peak Aquifer, general salinity problems, and the positive impact of brackish groundwater use as a drinking water source.

5.5.1 Arsenic

As discussed in the introductory section, the EPA has announced that the new arsenic maximum contaminant level (MCL) for drinking water is lowered from 50 to 10 parts per billion (ppb) with a compliance date of January 23, 2006. As can be seen in Figure 5-2, arsenic is found in concentrations above 10 ppb in significant numbers of results for the Hueco and Mesilla Bolsons and the West Texas Bolsons Aquifers. Smaller numbers of results above this screening limit are present in the Edwards-Trinity (Plateau) Aquifer. The new standard will have a significant impact on those public water supply entities that currently use groundwater with arsenic concentrations above 10 ppb.

The City of El Paso recently completed one of the largest arsenic removal plants in the country and the first in the state in order to meet this pending drinking water standard. This 30-mgd plant and three smaller plants cost $76 million to complete, and will allow the continued use of nearly 40 percent of the City's wells that contain elevated levels of arsenic. The larger plant will allow the City to treat groundwater produced from 24 of their wells in the Canutillo well field producing from the Mesilla Bolson Aquifer. The three smaller plants will remove arsenic from water produced from 31 wells in the Hueco Bolson Aquifer.

El Paso County Tornillo WID is also planning to construct an arsenic treatment facility. A discussion pertaining to this project is documented as Strategy E-23 in Chapter 4.

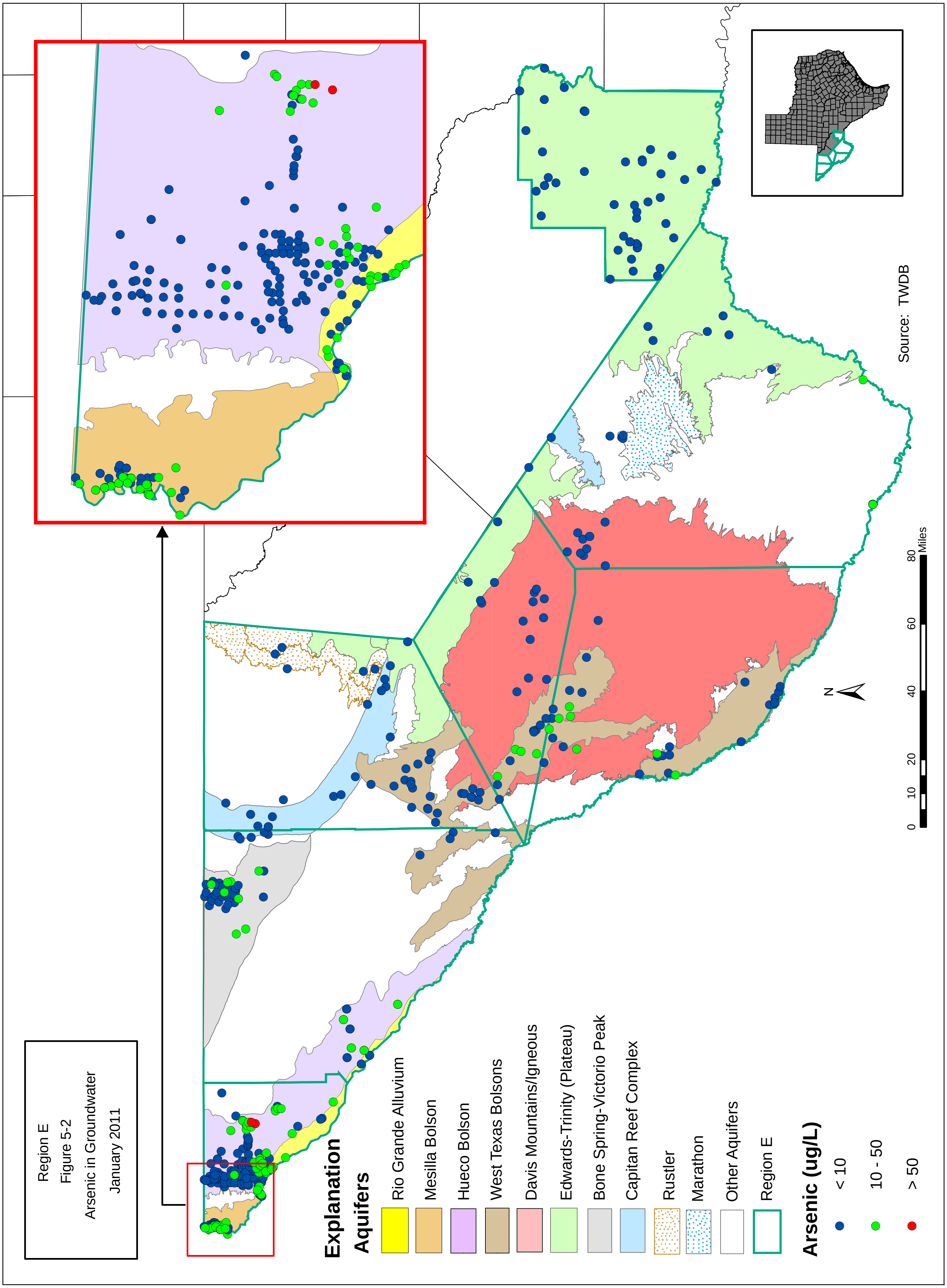

FIGURE 5-2. ARSENIC IN GROUNDWATER IN THE FAR WEST TEXAS REGION

LBG-GUYTON ASSOCIATES

5.5.2 Radioactivity

Another specific water quality issue for the region is radioactivity in groundwater. Alpha radioactivity is found above the primary MCL in 5 to 10 percent of the results in the Hueco and Mesilla Bolsons, Capitan Reef, West Texas Bolsons, and Davis Mountains Igneous Aquifers, and in nearly half of the results in the Bone Spring-Victorio Peak Aquifer. Radioactivity is a constituent of major concern in the resort town of Lajitas, where wells producing water from the deep Cretaceous limestones consistently have alpha radiation concentrations above the drinking water standard. This area currently has to treat groundwater to meet the applicable drinking water standards.

5.5.3 Bone Spring-Victorio Peak Aquifer Water Quality

Groundwater quality in the Bone Spring-Victorio Peak Aquifer contains high concentrations of chloride, sulfate, and TDS in nearly all sample results reported. Farmers in the area have been able to irrigate with this high salinity water by applying greater than normal quantities to the fields, thus flushing salts downward through the permeable soil horizon. This practice has prevented damaging salt buildup in the soils; however, the downward movement of salts over time has led to the slow water-quality degradation of the underlying aquifer (Figure 5-3).

5.5.4 SALT WATER ENCROACHMENT

“Salt-water encroachment” is a common term used to describe the migration of poorer quality water into a water well that has previously been withdrawing fresh water. This process has occurred in a number of City of El Paso public-supply wells and has resulted in the abandonment of several of these wells. Left unchecked, salt-water encroachment could eventually seriously affect the serviceable life of the well field. El Paso Water Utilities and Fort Bliss have jointly constructed a large desalination facility that serves two purposes. The facility extracts brackish groundwater to be desalinated from a location that will prevent the further migration of poorer quality water into the existing fresh-water well field. Also, by using brackish supplies to meet a portion of the total water demand, fresh groundwater sources are maintained for longer periods of time.

5.5.5 Salinity

Salinity of the Rio Grande has a significant impact on El Paso's surface water supply. Total dissolved solids in the river water increase almost two fold during low-flow periods when water is not being released from upstream reservoirs for irrigation use. The City's water treatment plants shut down when sulfate concentrations near 300 ppm or TDS approaches 1,000 ppm. This generally limits the City's ability to access surface water supplies to the months of March through August. Local organizations such as the Paso del Norte Watershed Council, supported by local universities and research centers, actively pursue measures to combat the growing problem of salinity. The El Paso Water Utility is a member of the Multi-State Salinity Coalition, an organization that seeks advancements in desalination-related technologies and salinity control strategies to enhance the quality and quantity of water sources.

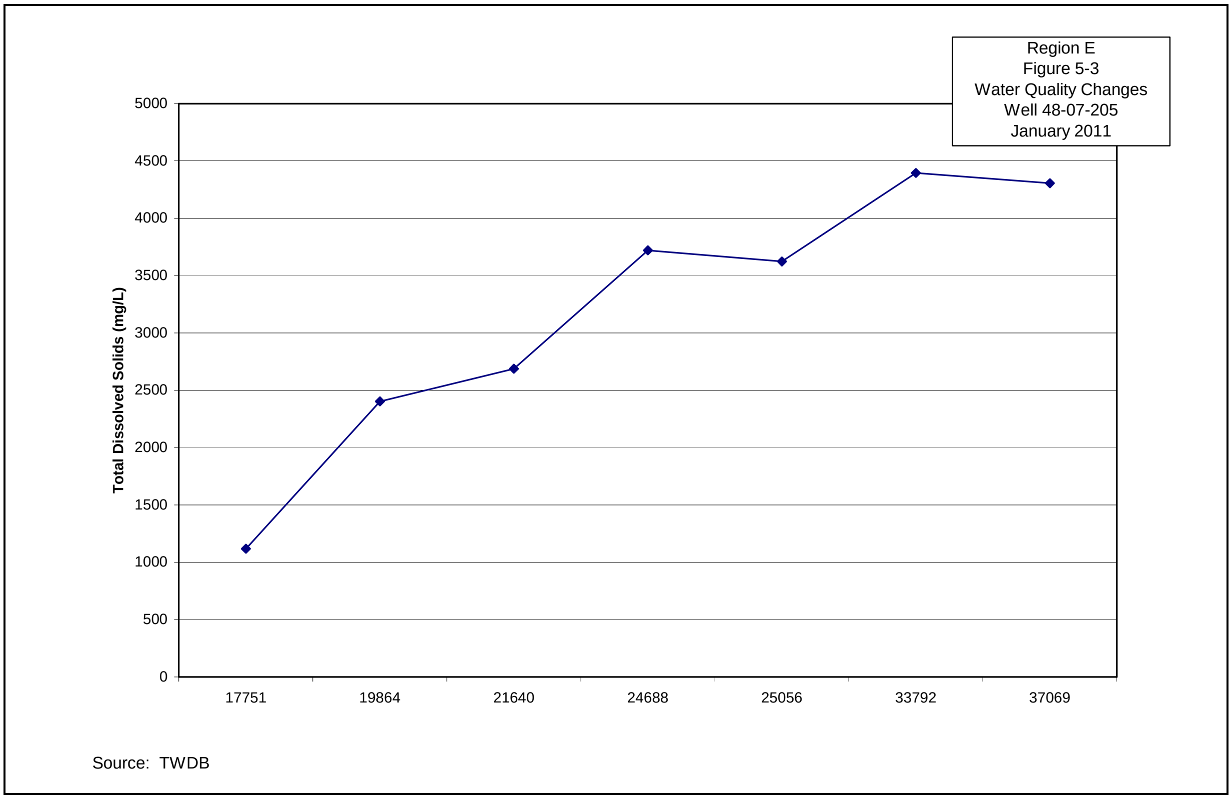

Figure 5-3. Water Quality Changes in Well 48-07-205 From 1948 to 2001

5.6 WATER QUALITY IMPACTS OF IMPLEMENTING WATER MANAGEMENT STRATEGIES

The El Paso County Integrated Water Management Strategy includes the conversion of surface-water rights, groundwater from the Bone Spring-Victorio Peak Aquifer in the Dell Valley area, and the Capitan Reef Aquifer underlying Diablo Farms. Water available under conversion of surface-water rights would have the same current quality of water used for irrigation, which is suitable for conventional treatment.

Groundwater from wells in the Dell Valley area contains concentrations of iron, chloride, nitrate, sulfate, and aluminum exceed water quality standards for municipal supply. Total dissolved solids in the area range from 1,810 to 3,900 mg/l. Desalination would be required before distribution for municipal use.

TDS concentrations in the Capitan Reef Aquifer range from 850 to 1,500 mg/l, although all the operating wells on Diablo Farms have TDS values below 1,000 mg/l. It is expected that significant increases above historical 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 require no desalination. Pumping between 10,000 and 25,000 acre-feet per year would be sustainable, but the groundwater would likely have to be desalinated over time. Pumping above 25,000 acre-feet per year would not be sustainable.

5.7 IMPACT OF MOVING WATER FROM AGRICULTURAL AREAS

The El Paso County Integrated Water Management Strategy involves the conversion of water and some properties previously used for agricultural purposes to municipal use. An additional 20,000 acre-feet per year from the Rio Grande would be obtained after the retirement of about 5,000 acres of land from irrigation. This represents a reduction of agricultural activities in El Paso County. Two factors drive this conversion: expected population growth in El Paso County and economics. As more people live in El Paso County, some cropland necessarily will be converted to urban use. In addition, as population grows the cropland adjacent to urbanized area will become more valuable than the crops produced on the land or the rights of the Rio Grande Project water associated with the land. At that point, many agricultural producers will make the decision to convert their property to residential, commercial or some purpose other than irrigated agriculture. This conversion is primarily the result of urbanization, not the implementation of this water management strategy. Conversion would be voluntary by lease, sale, or forbearance agreements.

The integrated strategy would also utilize the water rights for 24,000 acres of land in Hudspeth County, which would reduce irrigation activities near Dell City. The transfer to El Paso County is near 80 percent of the maximum limit. Conversion of water rights to transfer water to El Paso County would be voluntary. Land may became unsuitable for agriculture after extensive irrigation with brackish water due to accumulation of salt in the soil, and some acreage would be retired from irrigation regardless of how much water is exported to El Paso County. It is expected that irrigators will find it economically beneficial to transfer or sell their land or water rights. EPWU owns the land above the Capitan Reef Aquifer. Therefore, the conversion of use from agricultural to municipal will have no impact on agricultural ownership in that area.

Additional discussion pertaining to the economic impact of converting agricultural water to other uses (primarily municipal) is available in the TWDB "Socioeconomic Impact of Unmet Water Needs in Far West Texas" report provided as Appendix 4A in Chapter 4.

CHAPTER 6

WATER CONSERVATION AND

DROUGHT CONTINGENCY

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6.1 WATER CONSERVATION

Water conservation are those practices, techniques, programs, and technologies that will protect water resources, reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or increase the recycling or reuse of water so that a water supply is made available for future or alternative uses. Water conservation 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.

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.state.tx.us/publications/reports/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 this criteria are included in the appendices at the end of this chapter. These entities include El Paso Water Utilities (EPWU) (Appendix 6A), El Paso County Water Improvement District No.1 (Appendix 6B), and Hudspeth County Conservation and Reclamation District No.1 (Appendix 6C). 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.

6.1.1 Regional Water Conservation Recommendations

EPWU is the largest supplier of municipal water in Far West Texas, supplying approximately 72 percent of all municipal needs in 2010. The City of El Paso through the EPWU has been implementing an aggressive water conservation program for the past 13 years and has reduced the per capita demand from 200 gpcd in 1990 to a current level of less than 140 gpcd. The overall per capita potable water use for EPWU and its wholesale customers, including steam electric and industrial use, was about 133 gpcd in 2008. 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 4. El Paso's Water Conservation Plan is provided in Appendix 6A.

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 4, 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.

6.1.2 Water Conservation Considerations

6.1.1.1 Water-Saving Plumbing Fixture Program

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

Because 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.

6.1.2.2 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.

TWDB Report 362, Water Conservation Best Management Practices Guide was prepared in partial fulfillment of this charge. The Guide is organized into three sections, for municipal, industrial, and agricultural water user groups with a total of 55 Best Management Practices (BMPs). Each BMP 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. This document can be accessed at the following TWDB web site: http://www.twdb.state.tx.us/assistance/conservation/TaskForceDocs/WCITFBMPGuide.pdf

6.1.2.3 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.state.tx.us/assistance/conservation/consindex.asp . Likewise, Water Conservation Tips were developed by the TCEQ's Clean Texas 2000.

6.1.3 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)

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

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

Agricultural Uses –
Agriculture Water Conservation Plan-Non-Irrigation (TCEQ-10541)
System Inventory and Water Conservation Plan for Individually-Operated Irrigation System (TCEQ-10238)
System Inventory and Water Conservation Plan for Agricultural Water Suppliers Providing Water to More Than One User (TCEQ-10244)

6.1.4 Regional Water Loss Audit

Reported municipal use generally includes a variable amount of water that does not reach the intended consumer due to water leaks in the distribution lines, unauthorized consumption, storage tank overflows, and other wasteful factors. For some communities, attending to these issues can be a proactive conservation strategy that may result in significant water savings. To address the lack of information on water loss, the 78th Texas Legislature passed House Bill 3338, which required retail public utilities that provide potable water to perform and file with the TWDB a water audit computing the utility's most recent annual system water loss every five years. A summary of the first audit, An Analysis of Water Loss as Reported by Public Water Suppliers – 2007 (http://www.twdb.state.tx.us/RWPG/rpgm_rpts/0600010612_WaterLossinTexas.pdf) was provided to the Far West Texas Water Planning Group (FWTWPG) for consideration in developing water supply management strategies. The report lists utilities in Region E (Far West Texas) as having the lowest average value of nonrevenue water (approximately $14 per connection per year) of all 16 regions in the state. The FWTWPG acknowledges the value of this important planning tool, but identified apparent errors in some of the data. The report does offer the recognition that "as utilities refine their water audits, reducing balancing adjustments and improving real loss estimates, it is expected that water loss data reported from the next round of water audits will be more useful for planning purposes than the current water loss data. Based on this concern, the FWTWPG chose to not use the supplied data for this current Plan, but looks forward to the next improved water loss audit survey.

6.1.5 EPWU Conservation Outreach Project

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.

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.

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.

6.1.6 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.riocog.org/EnvSvcs/FWTWPG/publishe.htm. Also a summary of the report is provided as Appendix 1A in Chapter 1 of this Plan.

6.2 DROUGHT CONTINGENCY

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. In 2009, the Texas Water Development Board published "Drought Management in the Texas Regional and State Water Planning Process" (http://www.twdb.state.tx.us/RWPG/rpgm_rpts/0804830819_DroughtMgmt.pdf), which examines the potential benefits and drawbacks of including drought management as a regional water management strategy.

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.

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, the TCEQ requires all wholesale public water suppliers, retail public water suppliers serving 3,300 connections or more, and irrigation districts to submit drought contingency plans. For all retail public water suppliers serving less than 3,300 connections, the drought contingency plans must have been prepared and adopted no later than May 1, 2005, and shall be available for inspection upon request.

6.2.1 DROUGHT RESPONSE TRIGGERS

Droughts typically develop slowly and insidiously over a period of months or even years and can have a major impact on the region. Water shortages may also occur over briefer periods as a result of water production and distribution facility failures. Drought contingency plans provide a structured response that is intended to minimize the damaging effects caused by the water shortage conditions. A common feature of drought contingency plans is a structure that allows increasingly stringent drought response measures to be implemented in successive stages as water supply diminishes or 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 timely action is taken in response to a developing situation and that the response is appropriate to the level of severity of the situation.

Each water-supply entity is responsible for establishing its own drought or emergency contingency plan that includes appropriate triggering criteria. Depending on the water use category, the plan may ultimately affect the health and welfare of a large population or it may only affect the property of a single owner. Entities providing drought contingency plans to the Far West Texas Water Planning Group are listed in Section 6.3.

Drought response triggers should be specific to each water supplier and should be based on an assessment of the water user’s vulnerability. For instance, a user on a surface-water source is likely to experience shortage from a drought sooner than a user on a groundwater source, simply due to the nature of the supply source. 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 a storage tank. However, this type of trigger will likely come too late for the entity to know it is in trouble; therefore, a supply source trigger is preferable. Triggers based on demand levels can also be effective as long as the entity does not overestimate how far it can stretch its supply or how much water its retail customers can manage to conserve. 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.

6.2.2 Surface Water Triggers

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 (2002) is administered through EPWU and is based on three Drought or Water Emergency Stages: (1) A Stage I water emergency is triggered when water stored in Elephant Butte Reservoir is less than 500,000 acre-feet; or when the El Paso County Water Improvement District No. 1 (EPCWID#1) declares surface water allotment is less than 3.0 acre-feet per acre on or before March 15th; or when water demand is projected to exceed 90 percent of 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 2.5 acre-feet per acre on or before March 15th and river water quality is projected to exceed 300 parts per million (ppm) of sulfates or 1,000 ppm of total dissolved solids in April, May or September; or when water demand is projected to exceeds 95 percent of available capacity as determined by El Paso Water Utilities; (3) A Stage III water emergency is triggered when the EPCWID#1 declares surface water allotment of less than 2.0 acre-feet per acre on or before March 15th or river water quality is projected to exceed 300 parts per million (ppm) of sulfates or 1,000 ppm of total dissolved solids during the months of June, July and August; or when water demand is projected to exceeds 100 percent of available capacity as determined by El Paso Water Utilities. 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 should be 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.

6.2.3 Groundwater Triggers

Groundwater triggers that indicate the onset of drought in Far West Texas are not as easily identified as factors related to surface-water systems. This is attributable to (1) the rapid response of stream discharge and reservoir storage to short-term changes in climatic conditions within a region and within adjoining areas where surface drainage originates, and (2) the typically slower response of groundwater systems to recharge processes. Although climatic conditions over a period of one or two years might have a significant impact on the availability of surface water, aquifers of the same area might not show comparable levels of response for much longer periods of time, depending on the location and size of recharge areas in a basin, the distribution of precipitation over recharge areas, the amount of recharge, and the extent to which aquifers are developed and exploited by major users of groundwater.

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 2000 to 2050 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.

Because of the above described problems with using water levels as drought-condition indicators, most municipal water-supply entities in Far West Texas that rely on groundwater generally establish drought-condition triggers based on levels of demand that exceed a percentage of the systems production capacity. Table 6-1 provides a list of groundwater dependent entities, their supply source, their type of triggers and responses.

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.

Table 6-1. Suggested or Mandated Drought Triggers for Groundwater Dependent Entities

Water-Supply Entity	Entity Water Supply Source	Drought Trigger	Trigger Response
Alpine	Igneous Aquifer	Daily water demand exceeds 75% of production capacity.	Multi-stage limitation on water use.
Van Horn	West Texas Bolsons Aquifer (Wild Horse Flat)	1. System demand exceeds production or storage capacity measured over a 24-hour period.	4-stage increasing limitation on water use.
El Paso (EPWU) *	Hueco and Mesilla Bolson Aquifers	Drought triggers are based on three surface-water allotment stages beginning with an annual allotment of less than 3.0 acre-feet per acre.	EPWU Manager can implement a variety of response measures designed to conserve water.
Anthony	Mesilla Bolson Aquifer	Daily water demand exceeds 75% of production capacity.	Multi-stage limitation on water use.
Vinton	Mesilla Bolson Aquifer	1. Daily water demand exceeds 75% of production capacity; 2. Water levels in wells drop below pump intake level; 3. Power failure of over 30 minutes.	Multi-stage limitation on water use.
Horizon Regional MUD Horizon City	Hueco Bolson Aquifer	Daily water demand exceeds 75% of production capacity.	Multi-stage limitation on water use.
Dell City	Bone Spring-Victorio Peak Aquifer	Daily water demand exceeds 75% of production capacity.	Multi-stage limitation on water use.
Sierra Blanca	West Texas Bolsons Aquifer (Wild Horse Flat)	Linked to Van Horn	Linked to Van Horn
Fort Davis WSC Fort Davis	Igneous Aquifer	4 trigger levels beginning with mild shortages. Second stage begins when daily water demand exceeds 60% of production capacity.	4-stage increasing limitation on water use.
Marfa	Igneous Aquifer	Daily water demand exceeds 75% of production capacity.	Multi-stage limitation on water use.
Presidio	West Texas Bolsons Aquifer (Presidio Bolson)	Daily water demand exceeds 75% of production capacity.	Multi-stage limitation on water use.
Terrell County WCID #1 Sanderson	Edwards-Trinity (Plateau) Aquifer	3 trigger levels beginning when daily water demand exceeds 80% of production capacity.	3-stage increasing limitation on water use.

* The Far West Texas Water Planning Group considers groundwater triggers for El Paso (EPWU) not to be relevant.

Water-use categories in the Region other than municipal that are dependent on groundwater as their primary or only source of supply must rely on a number of factors to identify drought conditions. In most cases, atmospheric condition (days without measurable rainfall) is the most obvious factor. Various drought indices (Palmer, Standard Precipitation, and Keetch-Byram) are available from State and local sources. Groundwater conservation districts, agricultural agencies, as well as individuals can access these indices for use in determining local drought conditions and appropriate responses.

As discussed earlier in this section, groundwater levels in this part of the State have only limited use as drought triggers. Although numerous water-level measurements are available on a number of wells in the Region, most of this data represents only one measurement a year. This does not allow for observation of seasonal fluctuation or response to recharge events. However, Table 6-2 provides a selection of wells (one per aquifer) with a history of measurements and a proposed drought trigger level. Staff of the TWDB measure most of these wells annually. Wells selected for drought contingency triggers should be re-evaluated for appropriateness during the next planning period.

Groundwater conservation districts are generally responsible for monitoring conditions within their boundaries and making appropriate public notification. Outside of existing districts, the TWDB should assume responsibility of public notification of drought conditions based on their water-level monitoring network. Appropriate drought responses are the responsibility of and at the discretion of private well owners.

Table 6-2. Suggested Groundwater Level Triggers by Source

Aquifer	County	Well Number	Avg. Depth to Water in 1990s	Trigger Depth to Water
Hueco Bolson **	El Paso	49-13-710 EPWU #67	14.7 decline to 5.5 rise *	Unknown **
Mesilla Bolson **	El Paso	49-04-138 JL-EPWU #117	4.6 decline to 3.4 rise *	Unknown **
Rio Grande Alluvium	El Paso	49-04-701	6.4	7.3
Edwards-Trinity (Plateau)	Terrell	53-53-601	Unknown	30 ft. below avg summer depth
Bone Spring-Victorio Peak	Hudspeth	48-07-516	121	135
Davis Mountains Igneous	Brewster	52-35-709	113	144
Marathon	Brewster	52-55-106	Unknown	30 ft. below avg. summer depth
Rustler ***				
Salt Basin				
Wild Horse	Culberson	47-59-106	227	20 ft. below avg. summer depth
Lobo	Culberson	51-02-903	197	20 ft. below avg. summer depth
Ryan	Jeff Davis	51-19-902	109	30 ft. below avg. summer depth
Other West Texas Bolsons***				

* Ranges of annual drawdown.

** The Hueco and Mesilla Bolson aquifers are undergoing a continuous water-level decline and, therefore, a depth trigger is inappropriate. Water-level changes shown are related to normal variations in groundwater pumping at the well and the well field in general, and are not believed to be drought induced. Drawdown levels that may be used as drought triggers during drought-of-record conditions have <u>not</u> been identified in these or any other wells in the well field. However, due to their proximity to the Rio Grande, it is believed that these wells would be most likely to show effects if a drought-of-record were to occur.

*** Very little pumpage, if any, comes from these aquifers and, therefore, a depth trigger is meaningless.

**** Wells selected for drought triggers should be re-evaluated for appropriateness during next planning period.

6.2.4 Model Drought Contingency Plans

The TCEQ has prepared model drought contingency plans for wholesale and retail public water suppliers, water supply corporations, and investor owned utilities that meet the TCEQ's minimum requirements. The forms for the entity types listed below are available at http://www.tceq.state.tx.us/permitting/water_supply/water_rights/contingency.html. You can receive a print copy of the model plan by calling 512/239-4691, or by e-mail to wras@tceq.state.tx.us.

- Handbook for Drought Contingency Planning for Retail Public Water Suppliers.
- Handbook for Drought Contingency Planning for Wholesale Public Water Suppliers.
- Handbook for Drought Contingency Planning for Irrigation Districts.
- Model Drought Contingency Plan for the Investor Owned Utility.
- Model Drought Contingency Plan for the Water Supply Corporation.

The model drought contingency plans for the above categories incorporate the following guidelines:

- Specific, quantified targets for water use reductions
- Drought response stages
- Triggers to begin and end each stage
- Supply management measures
- Demand management measures
- Descriptions of drought indicators
- Notification procedures
- Enforcement procedures
- Procedures for granting exceptions
- Public input to the plan
- Ongoing public education
- Adoption of plan
- Coordination with regional water planning group

6.3 WATER CONSERVATION MANAGEMENT AND DROUGHT CONTINGENCY PLANS

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

Public Supply Entities

- City of Alpine - *Water Conservation and Drought Contingency Plan* (August 2005)
- Dell City – *Water Conservation and Drought Contingency Plan* (August 2000)
- El Paso County WCID #4 – *Drought Contingency Plan* (August 2000)
- El Paso Water Utilities – *El Paso's Water Conservation Plan* (2009)
- El Paso Water Utilities – *EPWU Drought and Water Emergency Management Response Plan* (November 2002)
- Esperanza Water Service Company – *Drought Contingency Plan* (August 2000)
- Fort Davis WSC – *Drought Contingency Plan* (August 2000)
- Fort Davis Estates – *Drought Contingency Plan* (August 2001)
- Green Acres/River View Water Works – *Drought Contingency Plan* (August 2000)
- Horizon Regional MUD – *Water Conservation and Drought Contingency Plan* (April 2005)
- Lajitas Utility Company – *Drought Contingency Plan* (November 2005)
- Marathon Water Supply and sewer Service Corp. – *Drought Contingency Plan* (July 2000)

- City of Presidio – *Water Conservation and Drought Contingency Plan* (August 2009)
- City of Sanderson – *Comprehensive Plan* (1994)
- Study Butte WSC – *Drought Contingency Plan* (April 2001)
- Terrell County WCID No.1 – *Drought Contingency Plan*
- Turf Water System – *Drought Contingency Plan* (August 2000)
- 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)

Irrigation Districts

- El Paso County Water Improvement District No.1 – *Management Plan*
- Hudspeth County Conservation and Reclamation District No.1 – *Management Plan*

6.4 GROUNDWATER CONSERVATION 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. 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." Five 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
- Presidion County Underground Water 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.state.tx.us/GwRD/GMA/gmahome.htm). This new process is summarized in Chapter 1, Section 1.2.1. The Brewster, Culberson, Hudspeth, Jeff Davis and Presidio districts are in GMA 4. As of October 1, 2009, *desired future conditions* have not been adopted for any aquifers in these GMAs.

6.4.1 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. Management goals (May 2009) include:

- Provide for the most efficient use of groundwater, conservation, and for the long-term sustainability and conservation of the groundwater resources
- Control and prevent waste of groundwater
- Address drought conditions
- Address in a quantitative manner the Desired Future Conditions of the groundwater resources in the District

6.4.2 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 District revised its management plan in December 2007, which establishes the following management goals:

- Implement a system to improve the basic understanding of groundwater conditions in the District
- Implement management strategies that will provide for the most efficient use of groundwater
- Each year strive to prevent the waste of water
- Minimize the influence of pumping of wells on the degradation of the aquifers by regulating the spacing of wells and by use of a Production Use Measurement Area
- Minimize the potential for contamination of groundwater by new or existing wells
- Monitor water export out of the District

- Implement management strategies that will address drought conditions
- Implement management strategies that will promote water conservation, recharge enhancement, rainwater harvesting, precipitation enhancement, or brush control where appropriate and cost effective
- Address the Desired Future Conditions of aquifers within the District

6.4.3 Hudspeth County Underground Water Conservation District #1

The Hudspeth County Underground Water Conservation District #1 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 latest District management plan adopted in 2002 includes the following management goals and activities:

- Provide for the most efficient use of groundwater
- Control and prevent the waste of groundwater
- Address natural-resource issues
- Curtail permitted withdrawals from the aquifer during periods of extreme drought
- Promote the efficient application of irrigation water to field crops

6.4.4 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 and portions of Brewster, Pecos and Presidio Counties within its jurisdiction. 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 following goals are included in the District's November 2008 revised management plan:

- Provide for the most efficient use of groundwater
- Control and prevent waste of groundwater
- Implement management strategies that will address drought conditions
- Implement management strategies that will promote water conservation
- Promote rainwater harvesting, recharge enhancement, precipitation enhancement, and brush control where appropriate

6.4.5 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 District developed a management plan in 2000 (revised 2003) which includes the following goals:

- Provide for the most efficient use of groundwater
- Control and prevent waste of groundwater
- Implement strategies that will address drought conditions
- Implement strategies that will promote water conservation.

APPENDIX 6A

EL PASO WATER UTILITIES - PUBLIC SERVICE BOARD

WATER CONSERVATION PLAN 2009

El Paso Water Utilities – Public Service Board
Water Conservation Plan 2009

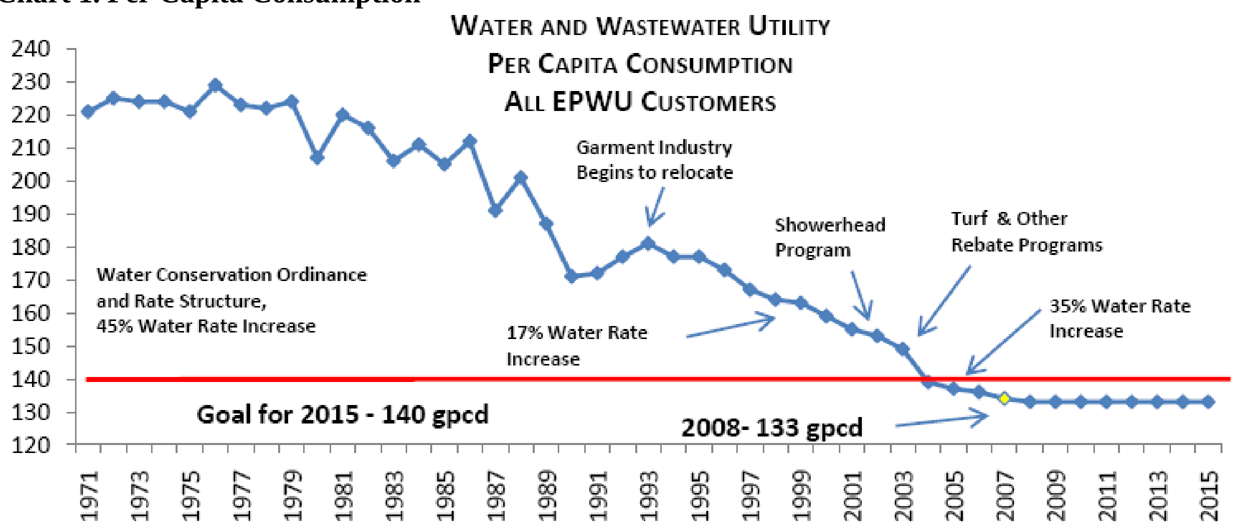
TABLE OF CONTENTS

I. CONSERVATION HISTORY

In 1990, the El Paso Water Utilities - Public Service Board named a 40 member Citizens Advisory Committee to look at all areas of water use and make recommendations for a water conservation program. This was in response to seasonally high peak demands as well as a growing concern of meeting long-term goals. At the same time, El Paso's Water Resource Management Plan was being finalized. One of the proposed measures included in the management plan was water conservation as the most economical way to help achieve projected water use savings. In addition, the Committee reported wasteful water use practices needed to be eliminated in order to successfully accomplish the 160 gallons per capita per day (gpcd) goal. The practices identified were lawn and garden irrigation, high volume plumbing fixtures, evaporative cooling and at-home car washing.

This report became the basis for El Paso's Water Conservation Ordinance that the PSB presented to City Council for approval in 1991. Consequently, the EPWU-PSB initiated a comprehensive water conservation program that includes a range of voluntary and mandatory programs as well as utility policy changes designed to help reach long-term goals. By implementing innovative water conservation measures such as permanent changes in ordinance affecting new and existing homes and businesses, water system optimization and higher cost of water by establishing an increased block rate structure, the El Paso water Utilities seek to reduce per capita use 20 percent, from the 200 gallons per capita day (gpcd) used in 1989 to 160 gpcd by the year 2000. The 2005 Water Conservation Plan outlined a goal of achieving less than 140 gpcd by 2010. We have achieved this measure and our updated goal is to maintain a level at, or below 140 gpcd until 2020.

Chart 1. Per Capita Consumption



In compliance with Title 30 TAC Chapter 288.2, this update to the Water Conservation plan is scheduled to be approved by the El Paso Water Utilities - Public Service Board during the August 26, 2009 regularly scheduled meeting. The Water Conservation Ordinance is included as Appendix A. There are no changes to the Drought and Water Emergency Management Response Plan (November 2002), therefore, approval by the Public Service Board is not necessary for this update. The Drought and Water Emergency Management Response Plan is included as Appendix B.

II. TARGETED GOALS FOR MUNICIPAL WATER USE CONSERVATION

Table 1 below illustrates the decline in gallons per capita day consumption for the El Paso service area. EPWU-PSB has successfully met the goals outlined in the 1991 and 2005 Water Conservation Plans. The current goal is to maintain overall per capita water consumption at or below 140 gpcd for the next 5 and 10 year planning periods (CY 2020). This goal is formally adopted in the EPWU-PSB Strategic Plan on an annual basis.

Table. 1 Historical Total System Water Consumption Data

Year	Population	Growth	Total Water*	GPCD**
1995	654,250	1.25%	40.34	177
1996	656,482	0.34%	40.11	172
1997	665,066	1.31%	39.72	167
1998	671,250	0.93%	39.95	164
1999	675,397	0.62%	40.7	163
2000	681,572	0.91%	40.43	159
2001	687,915	0.93%	39.15	155
2002	694,078	0.90%	38.46	153
2003	702,281	1.18%	36.99	148
2004	712,481	1.45%	34.66	139
2005	721,183	1.22%	35.17	137
2006	736,310	2.10%	35.46	136
2007	754,718	2.50%	35.64	134
2008	773,586	2.50%	35.32	133

*Billion Gallons
** Gallons per capita day

The El Paso Water Utilities – Public Service Board is dedicated to reducing the loss of water, improving the efficiency in the use of water and increasing the use of reuse water. Unaccounted for water and gallons per capita day (gpcd) figures are sourced in the Water Conservation Utility Profile (TWDB form WRD-264), which is included as attachment C.

Table 2. Unaccounted for Water

Year	Water Produced*	Water Consumed*	Unaccounted for Water*	Unaccounted for Water (%)
2004	34.66	32.04	2.62	7.56%
2005	35.17	32.57	2.60	7.39%
2006	35.46	32.60	2.86	8.07%
2007	35.64	32.88	2.76	7.74%
2008	35.32	32.28	3.04	8.61%

* Billion Gallons

El Paso Water Utilities has maintained a water loss rate of less than 10% for the last 7 years, which is considered “exceptional” by AWWA standards. The El Paso Water Utilities intends to maintain a water loss level below 10%, and a gpcd level of consumption below 140 gpcd, consistently through the next ten year planning period (CY 2020).

III. TRACKING TARGETS & GOALS – IMPLEMENTATION STRATEGIES

Leak Detection

EPWU has achieved this level of water loss through the implementation of a comprehensive leak detection program and universal metering. The leak detection program has saved more than700 million gallons of water per year. The Permalog system utilizes over 10,000 leak detection units throughout the water distribution system to monitors for leakage using acoustic-based monitoring techniques. When a leak is identified, the unit will send a signal to the EPWU staff with the location of the leak. This allows for constant monitoring of the distribution system.

Universal Metering

All metering devices used in the El Paso Water Utilities system are accurate to better than 5% within the designated flow range of the instrument. FY 08-09 meter reading accuracy was 99.91% with a goal of 99.94%, each year until FY 2014-15.This level of meter reading accuracy is equivalent to one inaccurate read for every 1,500 accurate meter readings. Meter accuracy is verified by ongoing testing and a program of meter replacement. EPWU has a complete meter shop with full testing facilities. We have over 50 customer classifications to insure that our entire customer base is in a billing and metered category.

Meter Replacement Program

The El Paso Water Utilities system is 100% metered both for customer and public uses. As a part of our water conservation implementation strategy, our meter replacement program is a long-term plan to replace meters at a rate that maintains a ten year average meter age. A cost / benefit analysis was conducted in 2002 by EPWU staff in order to estimate the appropriate time to change out small meters. Based on the results, it is recommended that the optimal meter age of replacement is 10 to 11 years. This will capture low water flows and ultimately raise revenue. For FY 09-10, our goal is to change out approximately 13,000 meters.

Maximizing Reuse Water

Wastewater within the EPWU service area is collected and treated at one of four EPWU wastewater reclamation plants using advanced secondary or tertiary treatment. Table 3 lists each wastewater treatment plant with the corresponding TCEQ number.

Table 3. Wastewater Treatment Plants

Wastewater Treatment Plan	Northwest WWTP	Haskell St. WWTP	Roberto Bustamante WWTP	Fred Hervey WWTP
TCEQ No.	WQ0010408009	WQ0010408004	WQ0010408010	WQ0010408007
Reuse Distribution	361 MG / year	273 MG / year	40.4 MG / year	1,823 MG / year

The result is high water quality that earned EPWU the reputation of operating the first wastewater treatment plant in the world to meet drinking water standards for its reclaimed water. EPWU supplies golf courses, city parks, school grounds, apartment landscapes, construction, and industrial sites with over 5.25 million gallons per day of reclaimed water. Reclaimed water is also used for the operation of treatment plants (in-plant use) and to recharge the Hueco Bolson through injection wells and infiltration basins. The goal for reuse water – as outlined in the EPWU-PSB Strategic Plan is to increase water reuse from 10% of total wastewater to 15% during the next ten year planning period (CY 2020).

IV. EDUCATION AND ENFORCEMENT

The Carlos M. Ramirez Tech$_2$O Center is in its second full year of operation as a state of the art water education facility. The Center serves educators, students, policy makers and the public by providing meeting places and resources to promote the understanding and study of water and water issues. It includes a 250-seat auditorium, a training center, interactive exhibits, and display and demonstration projects. The TecH$_2$O Center is ideal for regional, national and international symposiums and conferences. In 2008, the El Paso Water Utilities hosted the Region E Water Conservation Conference at the Tech2O Center.

El Paso Water Utilities is involved in many activities to increase public awareness about its water resources. The Water Conservation Education Department strives to increase water consciousness throughout the community and area schools. The El Paso area faces unique water challenges and it is our obligation to deliver this information throughout the area to help others understand how crucial it is to work collectively as a region to address the critical water issues. Our intent is to deliver the information in a meaningful and understanding way for all age groups. The El Paso Water Utilities Water Conservation program holds workshops and training sessions throughout the community on various subjects related to water conservation. There were 182 presentations made to local schools and community groups during the FY 08-09 year, with a goal set at 200 for FY 09-10.

The Water Conservation Department also offers brochures and conservation literature for all age groups. These materials are available to teachers and civic organizations who want more information on water efficient landscaping, free services and incentive programs offered to customers, and conservation tips for every household.

Table 4. Educational efforts by the Water Conservation Department

	Presentations	**Attendees**	Media Contacts
FY 1996-97	106	40,094	27
FY 1997-98	126	40,900	42
FY 1998-99	299	56,234	60
FY 1999-00	602	51,223	64
FY 2000-01	380	40,000	45
FY 2001-02	149	132,993	13
FY 2002-03	331	25,703	225
FY 2003-04	257	102,049	252
FY 2004-05	216	67,060	247
FY 2005-06	207	15,177	166
FY 2006-07	170	12,159	208
FY 2007-08	141	8,814	165
FY 2008-09	500	19,381	137

V. NON—PROMOTIONAL RATE STRUCTURE

The current water rate structure is an increasing block rate structure. Charges for water service are based on the customer's average winter consumption (AWC), which is the average of the amount of water used during the previous December, January, and February billings. (Customers who have not established an AWC are assigned an AWC based on meter size for their classification.) Up to 4 hundred cubic feet (CCF) are included in the minimum charge for residential customers.

Block	Charge per CCF	Volume Charge
1	$1.45 per CCF	Over 4 CCF's to 150% of AWC**
2	$3.40 per CCF	Over 150% to 250% of AWC
3	$4.87 per CCF	Over 250% of AWC

**Non residential customer rates do not include 400 cubic feet allotment in minimum monthly charges. Rates are current as of March 1, 2008.

Under the increasing block rate structure, irrigation accounts tend to have an extremely low Average Winter Consumption (AWC), which is used to calculate block thresholds. Accordingly, the vast majority of the water use in the summer by these accounts was billed at the higher block 2 and 3 rates. Some irrigation accounts were increasing their Average Winter Consumption (AWC) in order to avoid the summer excess rate.

The Utilities established a "Local Government Turf Irrigation Accounts" rate that bills water use based on monthly allotment levels. These levels are based on evapotranspiration measurements and allows for enough watering to replenish evaporation loss. Water use within the allotment is charged at $1.85 per CCF, usage above such allotments is charged at block 3 rates. Agencies such as public schools, universities and colleges are included in this rate.

TABLE 5. Monthly Allotment For Local Government Yard meter Accounts (Per Acre)

Month	**Maximum CCF Per Acre**	**Month**	**Maximum CCF Per Acre**
January	40	July	280
February	40	August	200
March	50	September	180
April	180	October	120
May	200	November	50
June	280	December	40

VI. WATERING SCHEDULE

Residential Watering is not allowed on Mondays, even numbered addresses are allowed to water on Tuesdays, Thursdays and Saturdays while odd numbered addresses, as well as schools, parks, cemeteries and industrial sites are allowed to water on Wednesdays, Fridays and Sundays. From April 1 through September 30, outdoor watering is allowed only before 10:00 a.m. or after 6:00 p.m. **Generally, municipalities will adopt restrictions on outdoor watering as a stage one restriction under a drought management plan. Lawn and Landscape watering restrictions are defined under the Mandatory Compliance section of the El Paso Conservation Ordinance, which means that this policy must be adhered to at all times, regardless of drought conditions.**

VII. MEANS OF ENFORCEMENT

Any water activity that causes water to spray or flow into the street or public right-of-way is prohibited and considered a violation. Violations are a class C misdemeanor in nature. Although the El Paso Water Conservation Ordinance does not require written warnings before a citation is given, the Conservation Department introduced the ordinance via warnings as part of their public education campaign. Washing of sidewalks, driveways, patios and other non-porous surfaces with a hose are prohibited except to eliminate dangerous conditions. These provisions are stated in the El Paso City Code, section 15.13. The enforcement of the conservation ordinance has been the responsibility of the El Paso Water Utilities since June of 1992 and allows for fines from $50 to $500 for each violation.

Table 6 below illustrates the Water Conservation Department efforts in implementing and enforcing the water conservation plan and all plan elements.

TABLE 6. Water Conservation Enforcement History

Year	Telephone	D-hanger	Verbal	Written	Citation	Conservation Line
1991*	40	1,025	1,268	208	29	n/a
1992**	388	152	449	77	14	n/a
FY 1996-97	925	355	1,145	410	192	1,634
FY 1997-98	450	549	554	478	400	2,179
FY 1998-99	505	594	727	279	227	11,882
FY 1999-00	595	671	924	253	269	12,091
FY 2000-01	610	2,697	4,447	141	210	21,409
FY 2001-02	509	3,000	1,646	400	300	18,500
FY 2002-03	669	777	1,409	143	1,054	14,830
FY 2003-04	509	1,731	1,604	291	804	11,292
FY 2004-05	284	478	759	131	309	19,991
FY 2005-06	239	458	716	115	237	20,892
FY 2006-07	873	410	701	123	171	18,546
FY 2007-08	769	357	651	390	28	12,597
FY 2008-09	599	365	331	70	40	n/a

VII. PERIODIC REVIEWS AND IMPLEMENTATION

The El Paso Water Utilities is obligated to the TWDB (under 31 TAC §363.71) to submit an annual report describing the implementation, status, and quantitative effectiveness of the water conservation program. This annual report is due within 60 days after the anniversary date of the loan closing for each year that the El Paso Water Utilities – Public Service Board is under financial obligation to the TWDB.

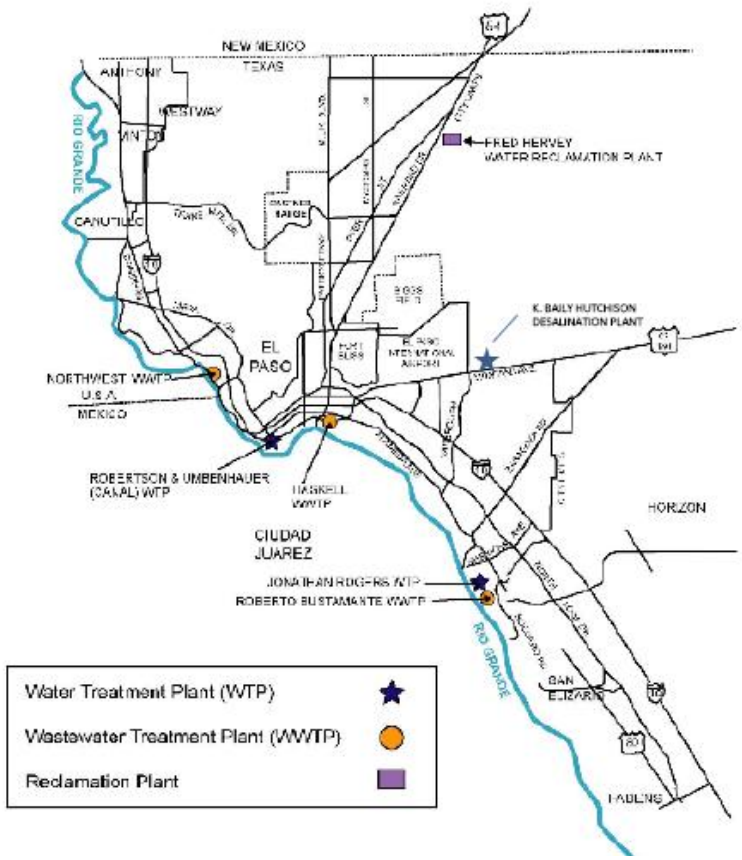
IX. COORDINATION WITH THE REGIONAL WATER PLANNING GROUP

The service area of the County of El Paso is located within the Region E Water Planning Area and the El Paso Water Utilities has provided a copy of the Plan to the Region E Water Planning Group.

Exhibit A is a map showing the water and wastewater system for the El Paso Water Utilities, Water and Wastewater System descriptions can be found in the Utility Profile.

EXHIBIT A

El Paso
Water & Wastewater System



APPENDIX A. WATER CONSERVATION ORDINANCE

Chapter 15.13 WATER CONSERVATION

15.13.005 Definitions.

All definitions contained in Section 15.12.005, Definitions, of Chapter 15.12 "Water and Sewer System" are incorporated into this chapter by reference. (Ord. 14805 (part), 2001)

15.13.010 Water conservation compliance.

No person who uses water from the city water supply system, the management and control of which the city council delegated to the El Paso water utilities public service board (public service board) by Ordinance No. 752, shall make, cause, use or permit the use of water received from the public service board for residential, commercial, industrial, agricultural, governmental or any other purposes in a manner contrary to any provisions of this chapter. Provided further, that no person shall make, cause, use or permit the use of water in a manner contrary to Section 15.12.075 of the city code or Section 15.13.040 of this chapter, regardless of whether that water is received from the El Paso water utilities public service board. When used in this chapter, the terms "commercial," "industrial," and "residential" shall have the meaning and usage consistent with the usage of those terms under Title 20, Zoning, of the city code. (Ord. 14805 (part), 2001: Ord. 10503 § 2 (part), 1991)

15.13.020 Mandatory compliance--Lawn and landscape watering.

The following mandatory restrictions shall apply to all customers of, or persons who use or receive water from the public service board:

A. All outdoor irrigation of grass, trees, plants or other vegetation on residential and commercial property on the side of the street on which building addresses are even numbered, may be done only Tuesdays, Thursdays and Saturdays; and on the side of the street on which buildings are odd numbered, such vegetation may be irrigated only on Wednesdays, Fridays and Sundays. In case of corner buildings having both odd and even numbers, the number carried on the books of the public service board shall control.

B. All outdoor irrigation of grass, trees, plants or other vegetation on industrial properties, parks, golf courses, schools and cemeteries may be permitted only on Mondays, Wednesdays and Fridays. All other properties, not falling within the industrial classifications described in this subsection, shall be considered residential and shall be watered in accordance with the requirements of subsection A of this section.

C. From April 1st to September 30th, all outdoor irrigation of vegetation is prohibited between the hours of ten a.m. and six p.m.

D. The review board of the public service board shall have the authority to review special situations and hardship cases upon application of any person in accordance with the procedures set forth in Section 15.13.060 of this chapter. (Ord. 14805 (part), 2001: Ord. 10942 § 2, 1992; Ord. 10503 § 2 (part), 1991)

15.13.030 Nonessential water use restrictions.

The following restrictions shall apply to all customers of or persons who use or receive water from the public service board:
A.1. The washing of automobiles, trucks, trailers, boats, airplanes and other types of mobile equipment shall be done only with a hand-held bucket or a hand-held hose equipped with a shut-off nozzle that completely shuts off the flow of water, even if left unattended. This restriction does not apply to the washing of the above-listed vehicles or mobile equipment when conducted on the premises of a commercial car wash or a commercial service station. When used in this chapter, “bucket” means a bucket or other container holding five gallons or less;
2. The washing of automobiles, trucks, trailers, boats, and other types of mobile equipment for fund-raising purposes must be conducted at a commercial car wash.
3. Prior to connection of water service to any commercial car wash issued building permits for construction after June 1, 2002, a certification shall be provided to the El Paso Water Utilities that the car wash uses no more than fifty gallons of water per vehicle washed. Absent such certification, no water service will be provided.
B. The following uses of water are defined as “wasting water” and are absolutely prohibited:
1. Irrigating any turf grass, tree, plant, or other vegetation, or otherwise utilizing the city water supply system to permit or cause water to pond, or to flow, spray or otherwise move or be discharged from the premises of any person responsible for any property within the corporate limits of the city, or which receives water from the public service board to or upon any street, alley, gutter or ditch, or other public right-of-way, or into a storm water drainage system or facility found in Section 19.16.050 of this code;
2. Failing to repair a leak within five working days of the discovery of same;
3. Washing sidewalks, driveways, parking areas, tennis courts, patios or other impervious surface areas with a hose, except in emergencies to remove spills of hazardous materials or to eliminate dangerous conditions which threaten the public health, safety, or welfare. “Impervious surface area” means any structure, street, driveway, sidewalk, patio or other surface area covered with brick, paving, tile or other impervious or nonporous material.
C. When referred to in this subsection, “swimming pool” shall mean any portable or permanent structure containing a body of water twenty-four inches or more in depth and containing one thousand one hundred twenty-two gallons or more of water and intended for recreational purposes, including a wading pool and as more fully defined under Section 20.02.820 of the city code. All swimming pools, which are constructed after the effective date of the ordinance codified in this chapter, must be equipped with filtration, pumping and recirculation systems. All existing swimming pools not equipped with such shall, within five years of April 1, 1991, be converted to filtration, pumping and recirculation systems, unless the review board, upon application of the pool owner or operator for a variance under Section 15.13.060 of this chapter, grants such a variance or extension of time. It is unlawful to drain swimming pools into the street, alley, gutter or other public right-of-way, ditch, or storm water drainage system or facility as defined in Section 19.16.050 of this code. Swimming pools may be drained into the sanitary sewer system only in coordination with El Paso water utilities’ wastewater system division manager.
D. New or replacement bleeder lines from evaporative coolers shall not be larger than one eighth-inch inside diameter. Bleeder lines shall be conducted outside and discharged so that the effluent can be used for water landscaping and other outdoor vegetation, except where this would be impractical or unfeasible.
E. No person shall use water for non-residential single pass cooling or heating purposes unless the water is reused for other purposes. “Single pass cooling or heating” means the use of water without recirculation to increase or decrease the temperature of equipment, a stored liquid or a confined airspace. (Ord. 15106 § 1, 2002; Ord. 14805 (part), 2001: Ord. 10505 § 2 (part), 1991)

15.13.040 Declaring of nuisance of exist.

The flow of produced water from property into streets, alleys, gutters, and other public rights-of-way, ditches, or into a storm water drainage system or facility, as defined in Section 19.16.050 of this code, is contrary to the public health, safety and welfare of the citizens of El Paso and is therefore declared to be a nuisance. “Produced water” shall have the same meaning as set forth in Section 15.12.005 (A) of the city code. Both the city attorney’s office and the attorney for the public service board are authorized to take legal action to abate such a nuisance, including but not limited to seeking injunctive relief. This authorization to seek injunctive relief, or other legal action to abate such a nuisance shall not preclude prosecution for a violation of this chapter. (Ord. 14805 (part), 2001: Ord. 10503 § 2 (part), 1991)

15.13.050 Large and very large users.

A. For the purpose of this section, a large water user is defined as "any person who uses an average of ten thousand gallons per day or more from the water supply system under the management and control of the public service board." A very large water user is defined as "any person who uses an average of one hundred thousand gallons per day or more from the water supply system under the management and control of the public service board."
B. All new very large water users, or existing very large water users, who apply for new service or an expansion of an existing service shall obtain approval from the public service board before being permitted to connect to the system or to expand within the system. Such large water users shall submit a water conservation plan to the Water Conservation Manager which contains a water use justification report that relates the water consumption to recycling potential and meets the requirements of subsection C of this section. The water conservation manager shall submit a recommendation, based upon this submittal to the public service board which shall render its decision within thirty days of the receipt of the recommendation from the water conservation manager. The water conservation manager shall review all water conservation plans submitted to determine whether the plan meets the requirements of this section. The public service board may approve the application for service with or without conditions, deny the application, or take any other action consistent with the policies expressed in this chapter.
C. All large water users who use more than an average of twenty-five thousand gallons per day shall prepare and submit to the water conservation manager, within six months of April 1, 1991, a water conservation plan, in accordance with this section as a condition for continued use or new service. All large water users, who use more than an average of ten thousand gallons per day but less than twenty-five thousand gallons per day, shall prepare and submit to the water conservation manager, within one year of April 1, 1991, a water conservation plan, in accordance with this section as a condition for continued use or new service. The water conservation plan must demonstrate that reasonable diligence will be used to avoid waste and achieve water conservation. The water conservation plan shall include techniques and technologies that will reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or increase the recycling and reuse of water. All conversion to recycling and reuse of water, if required, shall be accomplished within five years from the date of submittal of the water conservation plan. The water conservation manager may require additional information to be submitted which he/she deems necessary. If the water conservation plan demonstrates that the large water user will use reasonable diligence to avoid waste and achieve water conservation, the water conservation manager shall approve the plan. All approved water conservation plans shall be revised every five years. A fee of twenty-five dollars per plan submittal shall be assessed to defray administrative costs.
D. In considering approval of a water conservation plan, the water conservation manager and the public service board shall consider the climatic conditions, best management practices, best available techniques and technologies, the financial capacity of the applicant, and any other such factors which affect the policy of the city as expressed in the water resource management plan or the conservation policy of the state of Texas, as expressed in Section 1.003 of the Texas Water Code or applicable water conservation regulations providing for the conservation and development of the state's water resources adopted by the Texas Commission on Environmental Quality.
E. Any person whose water conservation plan is disapproved by the water conservation manager may appeal the decision to the review board, the public service board and the city council in accordance with the procedure set forth in Sections 15.13.060 and 15.13.070 of this chapter. (Ord. 16822 § 1 (part), 2008; Ord. 14805 (part), 2001: Ord. 10503 § 2 (part), 1991)

15.13.060 Variances and permits.

A. Owners of newly seeded or sodded turf grass and landscaping and new residential and commercial developments may receive a landscape watering permit upon application and approval by the water conservation manager allowing for daily watering of the same until the turf grass and landscaping are established, which shall not exceed thirty days.
B. The planning and development manager, water supply manager and general manager of the public service board, or his designee, shall be immediately established as a review board to review hardship and special cases which cannot fully comply with the provisions of this chapter after recommendation by the water conservation manager. The review board will review hardship or special cases to determine whether a particular case warrants a variance or permit and shall hear appeals from any person whose water conservation plan is rejected by the water conservation manager. The review board shall consider the facts of each case separately and decide whether to grant a variance or permit within ten working days of the receipt of a properly completed "Application for Variance/Permit" form which shall be developed by the water conservation manager. A variance

shall be granted only for reasons of economic hardship, medical hardship, or if there is a legitimate public health or safety concern that will be promoted or fulfilled as a result of granting the permit or variance. An “economic hardship” is defined as a threat to an individual’s or business’ primary source of income, and where not granting the variance would result in material structural damage to the person’s property. A “medical hardship” is defined as a situation where it is determined that a person’s ill health or medical condition requires a dependency upon others to water or irrigate. Under no circumstances shall inconvenience or the potential for damages of landscaping be considered an economic hardship or significant damage to property which justifies a variance. The review board shall authorize only the implementation of equitable water use restrictions which further the intent of the public service board’s water conservation plan. Any special water use restrictions authorized by the review board in each hardship or special case shall be set forth on the face of the variance or the permit. A fee of twenty-five dollars shall be assessed per application to defray administrative costs. The fee may be waived upon the execution of an affidavit stating that applicant for the variance is unable to pay the fee and such affidavit shall be sworn before a notary public. Final determination of an applicant’s inability to pay shall be made by the water conservation manager.

C. A variance or permit issued under this section expires under its own terms and conditions, but in no event shall a variance or permit be issued for a period of more than five years from the date of issuance. Any person issued a variance or permit must fully comply with all the provisions of this chapter as an express condition of that person’s variance or permit.

D. Any person who is issued a variance or permit and uses water supplied or delivered by the public service board shall provide proof of such variance or permit upon demand by any person authorized to enforce this chapter. Upon conviction of violating any provision of this chapter, the review board may revoke or suspend any permit or variance previously granted. Provided, however, the review board shall notify the permittee of the proposed revocation five working days before taking such action, and if within that time the permittee requests a hearing in writing, the permittee shall be given an opportunity to be heard by the review board prior to taking such action.

E. No prosecution for a violation of any provision of this chapter may be suspended for the sole purpose of allowing a person to obtain a variance or permit. (Ord. 14805 (part), 2001: Ord. 10942 § 3, 1992; Ord. 10503 § 2 (part), 1991)

15.13.070 Appeal to public service board and city council.

A. Any person who applies for a permit or variance under Section 15.13.060 and is denied such permit or variance by the review board, or whose permit or variance is revoked or suspended by the review board, or whose water conservation plan is disapproved by the review board, may appeal the decision of the review board by filing an intention to appeal in writing with the general manager of the public service board within five working days of the review board’s decision. If a proper appeal is timely filed, the public service board will hear the appeal within thirty days of the time the appeal is filed with the general manager. The public service board may take any action it deems necessary with regard to the appeal including denying same, granting same, or granting the requested permit or variance with conditions, or approving the water conservation plan. The decision of the review board shall be final and binding if there is no timely filing of an appeal in accordance with this section.

B. Any person, whose appeal to the public service board is denied, may appeal the decision of the public service board by filing an intention to appeal in writing with the city clerk within five working days of the public service board’s decision. If a proper appeal is timely filed, the city council will hear the appeal within thirty days of the time the appeal is filed with the city clerk. The city council may take any action it deems necessary with regard to the appeal including denying same, granting same or granting the requested permit or variance with conditions, or approving the water conservation plan. The decision of the city council shall be final and binding. The decision of the public service board shall be final and binding if there is no timely filing of an appeal in accordance with this section. (Ord. 14805 (part), 2001: Ord. 10503 § 2 (part), 1991)

15.13.080 Penalty.

Any person who violates any of the provisions of this chapter shall be deemed guilty of a misdemeanor and upon conviction, shall be punished by a fine not less than fifty dollars and not to exceed five hundred dollars. The violation of each provision of this chapter, and each separate violation thereof, shall be deemed a separate offense and shall be punished accordingly. (Ord. 14805 (part), 2001: Ord. 10503 § 2 (part), 1991)

15.13.090 Other enforcement action.

Nothing contained in Section 15.13.080, or any other provision of this chapter, shall prevent either the public service board or the city from seeking compliance with or enforcement of this chapter, from seeking injunctive relief in a court of competent jurisdiction, or from utilizing any other civil or equitable remedy to enforce the provisions of this chapter. Both the city attorney's office and the public service board's attorney are authorized to institute injunctive relief or any other civil action deemed necessary to enforce compliance with the provisions of this chapter. The public service board's attorney has no authority for criminal enforcement under this chapter. (Ord. 14805 (part), 2001: Ord. 10503 § 2 (part), 1991)

15.13.100 Exceptions to enforcement.

The following shall constitute exceptions from compliance with the provisions of this chapter:
A. The water is a result of natural events such as rain or snow;
B. The flow is a result of temporary failures or malfunctions of the water supply system;
C. The flow is a result of water used for firefighting purposes including the inspection and pressure testing of fire hydrants or the use of water for firefighting training activities;
D. The use of water is required for the control of dust or the compaction of soil as may be required by this code;
E. The water is used to wash down areas where flammable or otherwise hazardous material has been spilled and creates a dangerous condition;
F. The water is used to prevent or abate public health, safety or accident hazards when alternate methods are not available;
G. The water is used for routine inspection or maintenance of the water supply system;
H. The water is used to facilitate construction within public right-of-way in accordance with the requirements of the city and good construction practices;
I. The use of water is permitted under the terms of a variance, permit or compliance agreement granted by the review board or the public service board;
J. The water that is used for street sweeping, sewer maintenance or other established utility and public works practices;
K. Watering contrary to the even/odd watering requirements, under Sections 15.13.020(A) and 15.13.020(B), and from the time of day watering requirements under Section 15.13.020(C), may be permissible for one day only where application of chemicals requires immediate watering to preserve an existing lawn. In cases of commercial application, a receipt from a commercial lawn treatment company indicating the date of treatment, the address of the property treated, the name and address of the commercial contractor, and the chemical treatment required shall constitute evidence that the owner or person responsible for the property is entitled to this exception. Where treatment with a noncommercial application of chemicals requires immediate watering to preserve an existing lawn, the owner or person responsible for the property must contact the water conservation department prior to the application of chemicals and provide evidence satisfactory to the water conservation manager for approval of this exception;
L. Outdoor irrigation necessary for the establishment of newly seeded or sodded turf grass and landscaping in new residential and commercial developments;
M. Plants which cannot be kept alive without daily watering may be permitted to be watered from a bucket but not from the use of a hose on the days when watering is prohibited. (Ord. 14085 (part), 2001: Ord. 10942 § 4, 1992; Ord. 10503 § 2 (part), 1991)

15.13.110 Issuance of citations.

The water conservation manager or designee, or any other personnel authorized to issue class C misdemeanor citations are authorized to issue citations for violations of this chapter. (Ord. 14805 (part), 2001: Ord. 13152 § 129, 1997: Ord. 10503 § 2 (part), 1991)

15.13.120 Water emergency--Restriction of water use.

The general manager may implement the following additional restrictions and regulations curtailing water use upon the declaration of a water emergency by the mayor upon recommendation of the public service board:
A. Prohibit all restaurants from serving water to their customers except when specifically requested by the customer;
B. Prohibit the operation of any ornamental fountain or similar structure;
C. Suspend the issuance of all variances or permits hereunder;
D. Prohibit the filling, refilling or adding of water to all swimming pools;
E. Prohibit the washing of all vehicles and equipment except upon the premises of a commercial car wash;
F. Require that the washing of motor vehicles, airplanes, boats or other types of mobile equipment, upon the

immediate premises of a commercial car wash or a commercial service station, shall occur only between the hours of twelve noon and five p.m.
The mayor may declare a water emergency in case of a severe drought, in the event of any condition which interrupts the ability of the public service board to supply water, where curtailment of the use of water is necessary due to war, a natural disaster, to protect the public health, safety or welfare, or to preserve the water supply. In the event such water emergency is to continue for more than five days, such measures must be passed by resolution by majority of city council in order for the declaration of emergency to continue beyond the initial five day period. During such a water emergency, the general manager may impose any additional restrictions on the use of water from the city’s water supply system in all or in any part of the city as the city council may authorize. (Ord. 15106 § 3, 2002: Ord. 14805 (part), 2001: Ord. 10503 § 2 (part), 1991)

15.13.130 Turf grass prohibited.

A. Turf grass is prohibited in all parkways, narrow strips of land and sloped areas within new residential or commercial sites for which a building permit is issued after June 1, 2002, unless irrigated with sub-surface irrigation. For purposes of this section, “sloped areas” means an area with a slope ratio of one to three or greater from the horizontal. “Sub-surface irrigation” means a low pressure irrigation system installed below the surface of the ground or mulch, consisting of a water distribution system equipped with pre-installed water emitters that are rated by gallons per hour, and that is suitable for turf grass irrigation.
B. Turf grass for residential sites after June 1, 2002, shall not be used for more than fifty percent of the total area to be landscaped (front and back yard).
C. Turf grass for commercial sites after June 1, 2002, shall not be used for more than thirty-three and one-third of the total area to be landscaped (front and back yard). (Ord. 15106 § 2, 2002: Ord. 14805 (part), 2001)

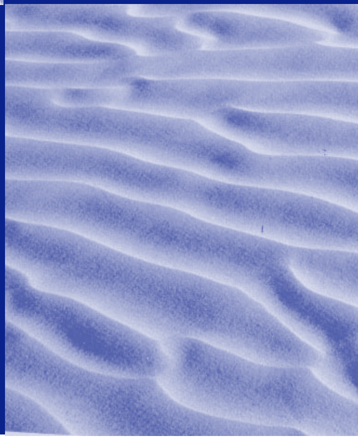
15.13.140 Drought and water emergency management response plan.

It shall be unlawful to violate the imposed provisions of the drought and water emergency management response plan, dated November, 2002, after the declaration of a drought or water emergency and imposition of restrictions in accordance with the plan. (Ord. 15375, 2003: Ord. 14805 (part), 2001)

APPENDIX B. DROUGHT AND WATER EMERGENCY MANAGEMENT RESPONSE PLAN

E l   P a s o   W a t e r   U t i l i t i e s

DROUGHT AND WATER EMERGENCY MANAGEMENT RESPONSE PLAN



EL PASO WATER UTILITIES PUBLIC SERVICE BOARD

November 2002

(as amended)

CONTENTS

ATTACHMENTS

EXECUTIVE SUMMARY

The Drought and Water Emergency Management Plan of the El Paso Water Utilities Public Service Board is an integral part of the overall Water Resources Management Plan for the El Paso area. Drought is a natural climatic condition which has occurred many times in the past and which will occur again. The purpose of this plan is to provide a management framework for dealing with drought. In addition, it may be used to manage water emergencies which result in temporary loss or reduction in service due to non-climate related factors.

As El Paso becomes more dependent on the Rio Grande as a renewable water source, it becomes more vulnerable to a drought induced water shortage. In the event surface water deliveries are curtailed to treatment plants, water deliveries to customers may be curtailed. This plan provides an equitable management framework to deal with curtailed water deliveries.

The Drought and Water Emergency Management Plan is triggered by reductions in surface water allotment or by the inability to satisfy system water demand for any reason. The plan is triggered in stages based on allotment or when demand is projected to exceed supply. Each drought or water emergency stage is associated with a menu of response measures. Each successive stage from Stage I to Stage III represents an increasingly severe condition and includes an increasingly stringent list of response measures.

Although the General Manager of the El Paso Water Utilities may ask for voluntary reduction in water consumption at any time, the Drought and Water Emergency Response Plan is intended to provide a structured framework of response that is approved by the City Council and available to the public in advance of the need to implement emergency measures. The Mayor may declare a water emergency in case of a severe drought, in the event of any condition which interrupts the ability of the Public Service Board to supply water, where curtailment of the use of water is necessary due to war, a natural disaster, to protect the public health, safety or welfare, or to preserve the water supply. In the event such water emergency is to continue for more than five (5) days, such measure must be passed by resolution by majority of City Council in order for the declaration of emergency to continue beyond the initial five (5) day period. During such a water emergency, the General Manager may impose any additional restrictions on the use of water from the city's water supply system in all or in any part of the city as the City Council may authorize.

PURPOSE

The purpose of this Drought and Water Emergency Management Response Plan is as follows:

- to provide contingency plans to manage drought and emergency conditions
- to continue to deliver a cost effective, adequate, safe and reliable supply of high quality water to our customers
- to assist in implementing the Water Resources Management Plan (1991) which identifies the need to plan for periods of critical water shortages as a result of either drought or emergency interruption to available water supplies
- to identify successful public information strategies which will motivate the community to reduce normal consumption to drought allowances
- to evaluate water emergency and drought management practices in various cities around the United States and to recommend the best practices for use in El Paso
- to identify critical points of change which would result in an acute or long term water outage city-wide or in selected areas and to establish preemptive stages to address the outage
- to recommend a programmed response for each stage which would most effectively reduce water consumption to the available supply with the least adverse impact on El Pasoans
- to comply with 30 Texas Administrative Code Section 288 Drought Contingency Plan Requirements

INTRODUCTION

Through the summer of 1996, a drought afflicted a portion of the country for more than one year. Many cities in this area such as San Antonio, Austin, Santa Fe and others implemented extraordinary measures to restrict water consumption because they suffered immediate water supply problems due to the lack of rainfall.

El Paso is in a different position. Our groundwater supplies are almost unaffected by precipitation. This can be expected by noting that the average annual rainfall is about 8 inches whereas the solar pan rate of evaporation is about 100 inches per year. Hence, we mine ground water from the Hueco Bolson, albeit at a somewhat greater rate during times of drought. For the shallow wells in the Mesilla Bolson, the water pumped is replaced by the Rio Grande and agricultural drains and canals. Thus, the shallow groundwater may be unavailable or available in limited amounts during a sustained drought. Deep wells in the Mesilla Bolson are under similar conditions as those in the Hueco Bolson. The water is being mined and the amount of natural recharge is insignificant in comparison to the amount being withdrawn. In addition, the continual draw down by pumping in the Hueco Bolson is resulting in a steady loss of well capacity due to intrusion of brackish and saline groundwater water. This is a long term problem, which would be aggravated by a drought.

Since 1993, El Paso has added about 20 MGD (million gallons per day) of well capacity in the Hueco Bolson and currently has under design and construction projects that will add another 13 MGD of capacity to the Hueco Bolson and 22 MGD of capacity to the Mesilla Bolson within the next three years. However, since 1993 El Paso has also lost 30 MGD of well capacity in the Hueco Bolson due to intrusion of brackish water. The Hueco Bolson is near full development and capacity will continue to decline in the future. El Paso is designing a 27.5 MGD desalination plant to treat brackish water from the Hueco Bolson.

However, in order to preserve our groundwater supplies as much as possible, El Paso has been increasing its reliance on renewable surface water supplies from the Rio Grande.

As discussed, a drought has almost no effect on El Paso's groundwater supplies, although increased use of groundwater due to unavailability of surface water would affect the aquifers. However, a drought can have significant effects on El Paso's surface water supplies.

Nearly all of the water in the Rio Grande originates as snowfall in the Southern Colorado and Northern New Mexico Mountains. The rainfall in the Mesilla and El Paso Valleys of the Rio Grande Basin has no significant effect on available water supply. The Rio Grande is regulated by several dams and reservoirs for water storage. Consequently, a drought in any given year in the Rio Grande Basin (much below average winter snowfall), would have little effect on El Paso's water supply. Water storage reservoirs would continue to supply water as needed. However, a long term drought of two or more years duration would have a significant effect on El Paso's water supply. The surface water allotment available to El Paso Water Utilities for treatment would be curtailed.

Historically, there have been significant long term droughts in the Rio Grande headwaters area. The most recent severe drought lasted from 1952 to 1957. However, reservoir levels did not completely recover from this drought until the 1970's.

In 2001, the allotment of 3.5 acre-feet per acre was significantly above the long term of 2.5 acre-feet per acre. However, in the Spring of 2002 the U.S. Bureau of Reclamation informed the irrigation districts that, due to persistent drought conditions affecting the Rio Grande watersheds in Northern New Mexico and Southern Colorado, there was a high probability that the surface water allotment for the year 2003 would be cut by up to 75%, depending on actual precipitation levels leading up to the start of the 2003 summer irrigation season. This has the potential to severely limit surface water supplies which will have a major impact on available water supplies to El Paso Water Utilities.

Such a shortage cannot be met with groundwater pumping alone. The Hueco Bolson is fully developed. In fact, some of the Airport Field wells, drilled in 1989, are already unusable since they produce water that exceeds Texas Commission on Environmental Quality (TCEQ) drinking water standards for chloride.

A short term drought mitigation measure is improved simultaneous management of both bolsons to maximize the fresh water which can be recovered. By using the Hueco Bolson Model, El Paso Water Utilities has recently developed and implemented a pumping schedule to help control lateral intrusions of brackish water, and is making plans to rehabilitate some of the downtown wells and blend their production with surface water from the Canal Street Plant during times of surface water drought. Also, the Utility has developed a list of blendable brackish wells which can be brought on-line during years of low surface water allocation.

For a long term drought protection, El Paso Water Utilities is currently in the design stages of a 27.5 MGD eastside desalination plant which will treat water from existing brackish well in the Montana-McRae Wellfield and from new brackish wells to be constructed along Loop 375. The desalination plant is a joint project with Ft. Bliss and is scheduled to be operational by early 2006.

Also, the Utility is actively investigating the concept of importing at least 15,000 acre-feet per year of desalinated water from Texas aquifers east of El Paso within 10 to 15 years. Once implemented, both of these projects should provide the Utility with some degree of long term drought protection and may possibly raise the trigger thresholds utilized for the declaration of Drought or Water Emergency. However, these projects will not negate the need for the City to cut water usage and mandate certain drought contingencies during times of severe drought when minimal or no surface water is available to the City. These actions will insure that the limited supplies available will be equitably distributed and used for essential purposes.

WATER EMERGENCY EFFECTS

A water emergency differs from a drought in duration and scope. A drought in the Rio Grande Basin will affect the entire region and will last for several months or years until snowpack and reservoir storage levels recover. A water emergency could affect only specific areas of El Paso and may last anywhere from hours to days.

A water emergency could arise from numerous potential problems. For example:

- Electric power failures or blackouts
- Water main breakage
- Contamination of the Rio Grande
- Abnormal high water demand

Each of these potential causes could result in reductions of water delivered to customers. A city-wide blackout would obviously affect the water supply to the entire city for the duration of the blackout. A main break would typically involve only a section of the city served by that main and would last until the main was repaired and returned to service. There are numerous other potential causes of water emergencies.

The plan as outlined in this document consists of a menu of response measures to be enacted in response to water shortages - either from drought or other emergencies. The plan would entail the inaction of response measures based on certain stages. The stages are based on two eventualities.

First, a water shortage may exist when the allotment of surface water from the Rio Grande Project is low. In recent years EPWU has had an allotment of 3.5 acre-feet per acre; however, the long term historical average is 2.5 acre-feet per acre. We can anticipate shortages to occur anytime the allotment is less than 3.0 acre-feet per acre and critical shortages when the allotment is less than 2.0 acre-feet per acre.

Second, EPWU obviously can anticipate widespread water shortages to occur whenever system demand is in excess of 100% of the available capacity. In fact, serious shortages can occur in localized areas of El Paso any time the system demand is in excess of 85% of the available capacity. This can occur regardless of the Rio Grande Project allotment and can be caused by system failures or power interruptions.

The following categories of response options are in use in most cities with successful programs:

- Public Education and Information for Voluntary Reduction - public information and education programs would be implemented at the earliest drought or emergency stage to make customers aware of the problem, to respond to customer concerns and questions, and to motivate the customer to take action to reduce water consumption. A major component of El Paso's water conservation program focuses on public education. These programs, featuring billboards, radio announcements, television announcements, and newspapers, are aimed at reaching the greatest amount of people in the largest water use category - residential customers. During a drought or emergency, these existing programs will become the core of an expanded program working with El Paso to reduce consumption. It has been estimated in other cities that a good public information program can reduce peak water consumption 5 to 15%; however, effectiveness can vary widely due to many factors. El Paso citizens are already water conservation oriented and per capita use has already been reduced over 20 percent in the past decade. Public education programs in El Paso would marginally reduce water consumption, but will prepare the public in the event Stage II or Stage III drought measures are necessary.
- Outdoor Water Use Restrictions and Bans - residential outdoor water use is a significant portion of daily consumption. Water consumption almost doubles in the summer months. In the early stages of the drought or emergency, outdoor water use restrictions would be mostly voluntary. However, starting with the second stage, some reduction in consumption is mandatory. Depending on the nature and duration of the crisis, outdoor water use restrictions and bans can reduce water consumption by 40%.
- Nonresidential Water Use Planning - because the highest percentage of water consumption is due to residential customers, implementation of water use restrictions for industrial and commercial customers is usually insignificant until the final stage of the drought or emergency occurs. It is estimated that the maximum amount of savings possible is about 3%.
- Drought or emergency surcharge - an important concern raised by drought or water

emergency is the negative impact on water system revenue as a result of successful water conservation and drought management. Unfortunately, the expenses for water treatment and distribution services actually increase during a drought or during emergencies. The surcharge also has the effect of reducing water demand as customers react to the increased cost of water. Most customers will eagerly comply with the plan; however, certain customers will continue to use water during a drought or water emergency such that use exceeds the limits and practices as outlined in this plan. However, by state law, the surcharge must be tied to revenue requirements. The surcharge will vary based upon the time, duration and amount of projected reduced water usage. The surcharge will be calculated on a case-by-case basis to recover lost revenue due to a reduction in usage due to mandatory water restrictions.

Drought or Water Emergency Stage Conditions

The onset of drought or the anticipated onset of drought or emergency conditions and the management techniques depend on the severity of the water emergency.

Stage 1: When water stored in Elephant Butte Reservoir is less than 500,000 acre-feet; or when the El Paso County Water Improvement District No. 1 declares surface water allotment is less than 3.0 acre-feet per acre on or before March 15th; or when water demand is projected to exceed 90% of available capacity as determined by El Paso Water Utilities.

Stage 2: When the El Paso County Water Improvement District No. 1 declares surface water allotment of less than 2.5 acre-feet per acre on or before March 15th and river water quality is projected to exceed 300 parts per million (ppm) of sulfates or 1,000 ppm of total dissolved solids in April, May or September; or when water demand is projected to exceed 95% of available capacity as determined by El Paso Water Utilities.

Stage 3: When the El Paso County Water Improvement District No. 1 declares surface water allotment of less than 2.0 acre-feet per acre on or before March 15th or river water quality is projected to exceed 300 ppm of sulfates or 1,000 ppm of total dissolved solids during the months of June, July and August; or when water demand is projected to exceed 100% of available capacity as determined by El Paso Water Utilities.

Note, for all stages, the surface water allotment is based on all available water rights.

Water Emergency: A water system failure due to weather, electrical or mechanical failure or contamination of source.

Available Capacity Considerations and Demand Projection

The sources of potable water available to El Paso include the Rio Grande and the Hueco and Mesilla Bolson aquifers. At any drought stage, or even before an anticipated drought, the General Manager is authorized to augment available water supplies by any means available within budgetary and time constraints.

Water supply augmentation includes utilization of the Canutillo Shallow Wells either directly into the distribution system or indirectly via the Rio Grande channel to the Canal Water Treatment Plant for treatment and distribution. Supply augmentation includes seeking variances as needed from the TCEQ to use groundwater supplies which do not meet maximum contaminant levels (secondary standards) for sulfate, chloride, iron, manganese and/or total dissolved solids. The water will be safe to drink but may have a salty taste. Such waters may be used as necessary to meet demands subject to TCEQ approval. However, the capacity of the distribution system to move water from these sources uniformly throughout the city is limited. Some areas of town may not have access to such emergency groundwater supplies. A list of emergency groundwater sources is included as an **Attachment.**

A projected demand histogram was developed from recent historical data. This histogram will be used to project the water system demand for any given month for peak and average conditions. Please refer to the **Attachment** labeled Projected Demand Histogram.

Drought and Water Emergency Response Management Stages

Specific drought and water emergency management responses are listed according to stage. Stages are dependant on the ability of El Paso Water Utilities to foresee points which would affect water allotments or water availability. Such restrictions apply only to the use of potable water. After implementation of the Drought and Water Emergency Response Plan, the General Manager is authorized to request implementation of any or all of the following:

Stage 1:

Stage 1 is used to prepare El Pasoans for an impending drought. EPWU will inform customers of the conditions and ask for a voluntary reduction in water usage. Stage 1 response options are:

1. A voluntary reduction goal of 25 percent in indoor and outdoor water use.
2. Increased public education.
3. Restaurants are requested to voluntarily discontinue serving water except upon request.
4. Hotels and motels are urged to implement water conservation measures, including the reduction of laundry water usage.
5. Manufacturing industries using water provided by El Paso Water Utilities are urged to decrease water consumption by 25 percent.
6. All private well operators are urged to reduce water use by 25 percent.
7. All other area water purveyors are requested to comply voluntarily with all drought management response measures. However, if wholesale water service contracts with these purveyors include specific drought or water emergency language, the contract supersedes this Drought and Water Emergency Management Response Plan.
8. The General Manager shall authorize additional personnel to issue citations for violations of the Water Conservation Ordinance and the Drought and Water Emergency Management Response Plan, consistent with Civil Service rules.

STAGE 2:

All Stage 1 response options remain in effect.

Additionally:

1. Outdoor watering will be limited to once per week as per the following schedule. Watering will occur before 9:00 a.m. and after 7:00 p.m. and shall be limited to two hours per day. The last number of the street address shall determine watering days.

   Watering Schedule

Day of Week	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Last # of Address	-	0	1,3	2,4	5	6,8	7,9

   (Outdoor watering performed with a permanent drip irrigation system, sub-surface irrigation, or reclaimed water is exempt. Using a bucket to water trees, shrubs and flowers is permitted. Using household greywater is encouraged.)
2. Parks and schools served by El Paso Water Utilities shall water in accordance with a special permit issued by El Paso Water Utilities and will reduce consumption by a specific amount per month based on reduction targets set by EPWU to meet basic demand. (Parks and schools irrigating with reclaimed water are exempt.)
3. Golf courses irrigating with potable water supplied by El Paso Water Utilities and municipal golf courses shall water in accordance with a special permit issued by El Paso Water Utilities and will reduce consumption by a specific amount per month based on reduction targets set by EPWU to meet basic demand. (Golf courses irrigating with reclaimed water are exempt.)
4. Water used to provide for the health, safety and welfare of the El Paso Zoo animals is not subject to the water emergency responses listed herein. Zoo water requirements will be as determined by the Zoo Director.
5. Nurseries shall water plant stock in accordance with a special permit issued by El Paso Water Utilities.
6. No new landscaping shall be installed or planted and no new landscape watering permits will be issued except for Xeriscapes which are drip irrigated using a permanent system, use subsurface irrigation, or are irrigated with reclaimed water. New landscaping watering permits shall be granted for a 7-day period for landscaping that incorporates compost in the area at a rate of 5 cubic yards per 1000 square feet of turf.
7. All evaporative coolers that require a bleed-off system must have a restricted bleed-off line or an automatic drainage system.

8. All water conservation ordinance variances are automatically suspended and no new variances will be issued.
9. Routine fire hydrant flushing and testing shall be curtailed.
10. Existing swimming pools cannot be drained and filled with potable water supplied by El Paso Water Utilities after April 1. Single-family residential swimming pools must be covered when not in use. Pools can be topped off to replace water loss by evaporation.
11. Upon a second violation of the Drought and Water Emergency Management Response Plan, the General Manager may order the installation of a restriction device or downsizing of the water meter at the customer's cost.
12. Restaurants shall serve water only on request.
13. Misters shall not be operated, except by special permit for health and safety reasons.
14. Water can be used for aesthetic purposes, such as ornamental fountains, in accordance with a special permit issued by El Paso Water Utilities.
15. Impervious surface cleaning with potable water shall be prohibited, except where conducted by order of the City-County Health and Environmental District or the Police and/or Fire Department.
16. Hotels and motels must implement water conservation measures, including the reduction of laundry water usage.
17. A drought surcharge may be added to water rates.
18. Large housing complexes shall be allowed additional time to water on their designated day, on a case-by-case basis by permit, to be approved by the El Paso Water Utilities Water Conservation Department.

STAGE 3:

All Stage 1 and 2 drought management response options shall remain in effect. Additionally:

1. All outdoor watering is prohibited, except when performed with a bucket or permanent drip irrigation system, subsurface irrigation, or where reclaimed water is used.
2. The irrigation of golf courses with potable water supplied by El Paso Water Utilities and the irrigation of municipal golf courses is prohibited.
3. All car, trailer, truck, or boat washing is prohibited, except in facilities certified by El Paso Water Utilities and displaying approved signage.

4. No swimming pools shall be filled.
5. All water use for construction, dust control and/or compaction is prohibited, except with reclaimed water or brackish groundwater.
6. New water meters shall be approved for connection to the water system only as required for military expansion and/or high priority economic development projects, as determined by the General Manager and the Public Service Board.
7. All street sweeping shall be discontinued, except that performed with reclaimed or brackish groundwater.

WATER EMERGENCY:

Note, any combination of management response options may be used city-wide or in any section of the city as circumstances demand. Also, none of these measures will affect public safety, hospitals, evaporative air conditioning and sanitary uses.

DROUGHT PLAN VARIANCES:

Customer specific variances may be granted in cases of hardship or special conditions. After recommendation by the Water Conservation Manager, an El Paso Water Utilities review board will consider hardship or special cases to determine whether a particular circumstance warrants a variance. A variance shall be granted only for reasons of severe economic hardship, medical hardship or for a legitimate public health concern. A fee of forty dollars shall be assessed per application to defray administrative costs. The fee may be waived upon the execution of an affidavit stating that applicant for variance is unable to pay the fee.

ENFORCEMENT:

Any person violating any provisions of this plan shall be deemed guilty of a misdemeanor and upon conviction shall be punished by a fine as provided in Sec 15.13.080 of the El Paso City Code.

WHOLESALE CUSTOMERS:

In accordance with the Texas Water Code Sec 11.039, when necessary, water deliveries to wholesale customers shall be curtailed on a pro rata basis. Every wholesale water contract entered into or renewed after adoption of the Plan, including contract extensions, shall include a provision that in the case of a shortage of water resulting from drought, the water to be distributed shall be divided in accordance with the Texas Water Code Sec 11.039.

The General Manager of the El Paso Water Utilities shall report the nature and severity of the drought or water emergency condition to the Public Service Board. If the Public Service Board finds that a drought or water emergency condition exists, the Board shall recommend that the Mayor and City Council of the City of El Paso declare a drought or water emergency and impose measures provided in this Plan to protect the City's water supply. The Public Service Board shall be charged with all public notification and education activities related to the drought or water emergency and the restrictions imposed upon water users to conserve water. The Public Service Board shall continually monitor the drought or water emergency condition and promptly recommend that the declaration be rescinded or modified as warranted by changing conditions.

In the event of a sudden emergency, the General Manager of the El Paso Water Utilities or a Public Service Board member may contact the Mayor and request emergency action by the Mayor. The Public Service Board or General Manager may also request cooperation from citizens to immediatley address a water emergency. The Mayor may declare a water emergency in case of a severe drought, in the event of any condition which interrupts the ability of the Public Service Board to supply water, where curtailment of the use of water is necessary due to war, a natural disaster, to protect the public health, safety or welfare, or to preserve the water supply. In the event such water emergency is to continue for more than five (5) days, such measure must be passed by resolution by majority of City Council in order for the declaration of emergency to continue beyond the initial five (5) day period. During such a water emergency, the General Manager may impose any additional restrictions on the use of water from the city's water supply system in all or in any part of the city as the city council may authorize.

The General Manager of the El Paso Water Utilities shall notify the Executive Director of the TCEQ within five days following implementation of any mandatory water use restriction.

Acre-Feet — An acre-foot covers 1 acre of land 1 foot deep, and is equivalent to 325,850 gallons of water.

Aesthetic Use — The use of water for fountains, waterfalls, golf course water hazards and landscape lakes and ponds where such use is predominately ornamental and serves no other purpose.

Automatic Drainage System — An electric water pump that periodically (6, 8 or 12 hours) pumps all the water from the air-conditioner tank, thereby allowing the tank to be replaced with fresh water.

Available Capacity — The projected firm capacity of the system to deliver water based on the number of wells in service, water treatment plant production capacity and available river supplies, in service booster pumping capacity, equipment outages and other factors. The capacity in million gallons per day shall be projected by the Water Systems Division Manager.

Bucket — A container holding five gallons or less used singly by one person.

Drought Surcharge — An important concern raised by drought is the negative impact on water system revenue as a result of mandatory reduced water usage. The Utility still incurs operating and capital costs that must be recovered through revenues. The drought surcharge is designed to recover the Utility's costs during these reduced water usage periods. The surcharge will vary depending upon the time, duration and amount of projected reduced water usage.

The surcharge is calculated to recover lost revenue due to a reduction in usage due to mandatory water restrictions. The surcharge will be charged on all consumption in Blocks II and III during the drought period. The Public Service Board will set the fee and periodically adjust it depending on the severity of the drought.

Existing Landscaping Plant A landscaping plant existing in an area after such period of time as to accomplish an establishment and maintenance of growth.

Fleet A group of motor vehicles, five or more in number under the ownership or control of one person, corporation or partnership.

Greywater Wastewater that has not been contaminated by fecal material. Examples include wastewater from lavatories, bathtubs, showers and other fixtures.

Impervious Surface Area Any structure, street, driveway, sidewalk, patio or other surface area covered with brick, paving, tile or other impervious or nonporous material.

Landscaping Plant Any member of the kingdom Plantae, including any tree, shrub, vine, herb, flower, succulent, ground cover or grass species that grows or has been planted out-of-doors.

Landscape Watering The application of water to grow new or existing landscaping plants.

New Landscaping Plant Any landscaping plant planted in or transplanted to an area after a Drought or Water Emergency is declared.

Permanent Drip Irrigation A permanent underground water saving irrigation system using drip emitters, porous pipe, or similar means with precipitation rates measured in gallons per hour.

Restriction Device An orifice designed to restrict the flow of water from the water supply through the water meter to the customer.

Swimming Pool Any structure, basin, chamber or tank, including hot tubs, containing water for swimming, diving or recreational bathing and having a depth of two feet or more at any point.

Xeriscape A design concept that utilizes the implementation of drought tolerant plant material, efficient irrigation utilizing drip or subsurface irrigation, limited turf area with adequate soil depth, mulching of all planter beds and proper maintenance.

ATTACHMENTS

CALCULATION OF DROUGHT SURCHARGE

The actual surcharge will vary based upon the time and duration of the drought or water emergency and upon the amount of projected reduced water usage. The surcharge is designed to recover lost revenue due to a reduction in usage caused by mandatory water restrictions.

EXAMPLE CALCULATION OF SURCHARGE:

Estimated reduction in water usage	25 MGD *(million gallons per day)*
Estimated duration of drought	30 days
Total reduction in water usage	750 MG *(million gallons)*
* Total reduction in water usage	1,002,674 CCFs *(100 cubic feet)*
Time period for mandatory water restrictions	July

STEP 1 Obtain the previous year's Block II and III usage for the same time period and subtract the estimated reduction in water usage and multiply that number by the Block II rate to obtain the projected reduced revenue.

	USAGE (CCFS)		RATE		REVENUE
Block II usage and revenue for July	1,240,000	x	$1.61	=	$1,996,400.00
Block III usage and revenue for July	385,000		$2.07	=	+$ 796,950.00
	1,625,000				$2,793,350.00
* Less projected reduction in water usage	1,002,674				
Remaining usage	622,326	x	$1.61	=	-$1,001,944.86
					$1,791,405.14

STEP 2 Take the total revenue amount from Blocks II and III and divide that amount from the remaining usage amount to equal the calculated surcharge.

Calculated surcharge	**REVENUE**	÷	**USAGE**	=	**SURCHARGE**
	$1,791,405.14	÷	622,326	=	**$2.88 per CCF**

Example: Typical residential bill

Water Average Winter Consumption in ccfs 11

July water usage in ccfs 28

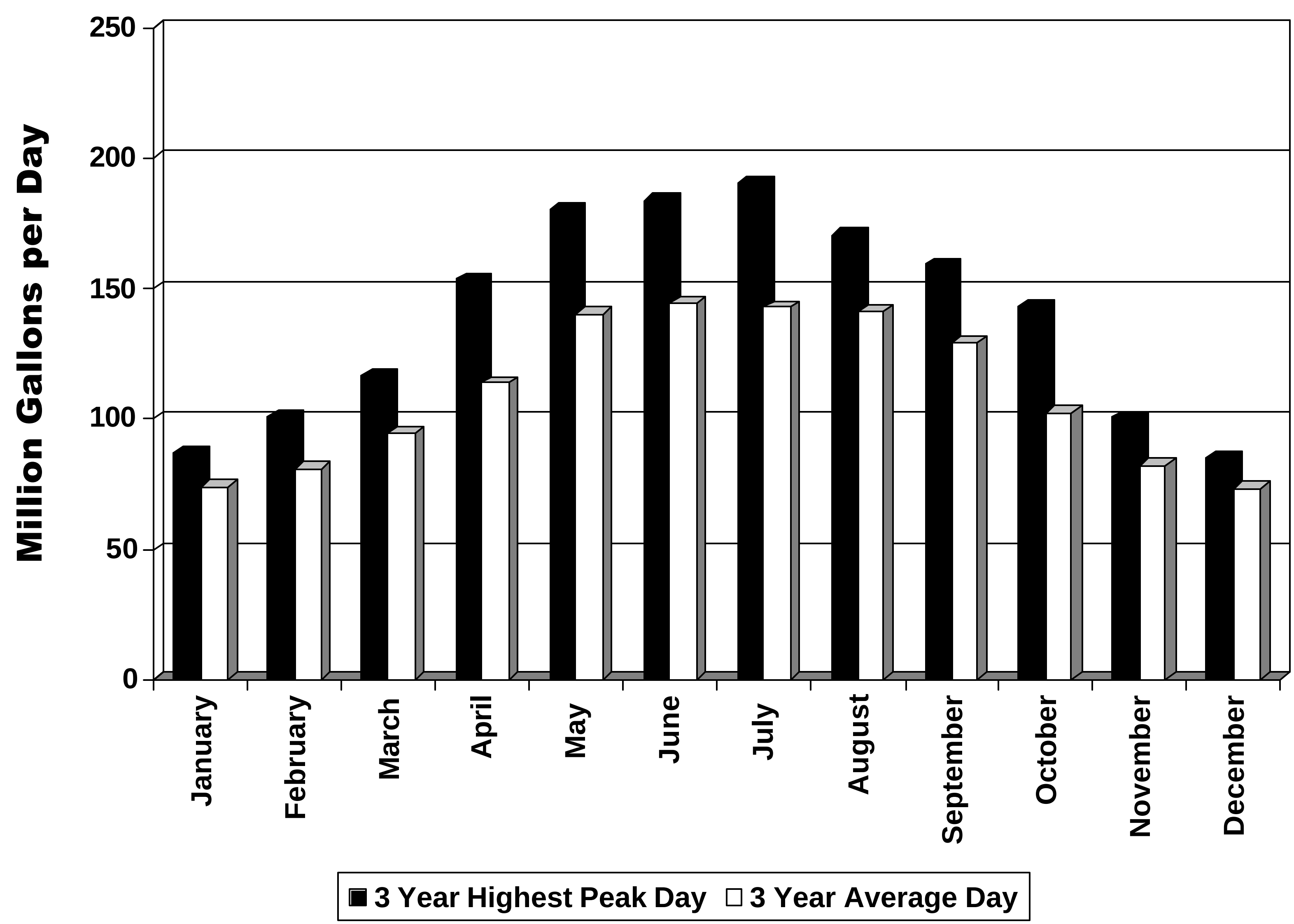
	Usage in ccfs	Unit Charge	Bill
Water Supply Replacement Charge		$3.96	$ 3.96
Minimum Charge (includes four ccfs)	4	$3.73	$ 3.73
Block I (over 4 ccfs to 150% of AWC)	13	$0.85	$12.75
Block II (over 150% to 250% of AWC)	11	$1.61	$14.49
Block III (over 250% of AWC)	0	$2.07	$ 0.00
	28		$34.93
Drought Surcharge - Blocks II & III usage	9	$2.88	$25.92
Total Water Bill			**$60.85**

EMERGENCY GROUNDWATER SOURCES

Well Number	MGD	Geographic Location	Booster Station	Classification
404A	.035	Lower Valley	Direct	Operational by Recharge
412A	0.70	Lower Valley	Direct	Operational by Recharge
419	0.71	Lower Valley	Direct	Operational by Recharge
420	0.58	Lower Valley	Direct	Operational by Recharge
10A	0.83	Water Plant	Water Plant	Excessive Chloride & Blendable
35	1.48	Mesa-Nevins	Northeast / Nevins	Excessive Chloride & Blendable
43	1.65	Mesa-Nevins	Nevins	Excessive Chloride & Blendable
49	1.63	Cielo Vista	Cielo Vista	Excessive Chloride & Blendable
53	1.68	Mesa-Nevins	Northeast / Nevins	Excessive Chloride & Blendable
71	0.81	Eastwood	Eastwood	Excessive Chloride & Blendable
92	1.59	Airport	Montana / McRae	Excessive Chloride & Blendable
93	1.65	Airport	Montana / McRae	Excessive Chloride & Blendable
96	0.71	Eastwood	Vista Hills	Excessive Chloride & Blendable
99	1.28	Airport	Montana / McRae	Excessive Chloride & Blendable
503	1.07	Airport	Montana / McRae	Excessive Chloride & Blendable
504	1.18	Airport	Montana / McRae	Excessive Chloride & Blendable

9A	1.94	Town	Direct	Excessive Chloride & Not Blendable
14A	1.04	Town	Direct	Excessive Chloride & Not Blendable
81	0.78	Lower Valley	Direct	Excessive Chloride & Not Blendable
82	0.48	Lower Valley	Direct	Excessive Chloride & Not Blendable
83	0.51	Lower Valley	Direct	Excessive Chloride & Not Blendable
84	0.89	Lower Valley	Direct	Excessive Chloride & Not Blendable
87	0.51	Lower Valley	Direct	Excessive Chloride & Not Blendable
97	2.07	Airport	Montana / McRae	Excessive Chloride & Not Blendable
408	1.11	Lower Valley	Direct	Excessive Chloride & Not Blendable
413	0.81	Lower Valley	Direct	Excessive Chloride & Not Blendable
414	0.92	Lower Valley	Direct	Excessive Chloride & Not Bendable
415	0.88	Lower Valley	Well 403	Excessive Chloride & Not Blendable
416	0.82	Lower Valley	Direct	Excessive Chloride & Not Blendable
417	0.82	Lower Valley	Direct	Excessive Chloride & Not Blendable
421	0.80	Lower Valley	Direct	Excessive Chloride & Not Blendable
422	0.75	Lower Valley	Direct	Excessive Chloride & Not Blendable
506	1.32	Airport	Montana / McRae	Excessive Chloride & Not Blendable

2003 Projected Demand



El Paso Water Utilities
2002 PUBLIC WORKING COMMITTEE

Member Roster

Organization	Representative(s)
1. Canutillo Independent School District	Jose Villareal
2. Catholic Diocese of El Paso	Rev. Carment Mele
3. Chevron El Paso Refinery	Victor Nevarez
4. City of El Paso Building & Zoning Advisory Committee	Conrad Conde
5. City of El Paso Building Permits & Inspection Dept.	Suzanne Santo
6. City of El Paso Parks & Recreation Dept.	Ray Cox Richard Garcia
7. City of El Paso Planning Dept.	Patricia Adauto
8. Clint Independent School District	Marcos Chavez Rito Carrera
9. Desert Sun Pools	Larry Davidian
10. El Paso Apartment Association	Mary Cardenas Ray Baca
11. El Paso Association of Builders	Danny Salazar
12. El Paso Association of Remodelers/NARI	Eric Lowenberg
13. El Paso Black Chamber of Commerce	Bob Snead
14. El Paso Car Wash Association	Lamar Skarda
15. El Paso City-County Health & Evironmental District	Dr. Jorge Magaña
16. El Paso Community College	Larry Galvan
17. El Paso Electric	Danny Sanchez
18. El Paso Employees Federal Credit Union	Raymond Ponteri
19. El Paso Hispanic Chamber of Commerce	Cindy Ramos-Davidson
20. El Paso Independent School District	Frank Hernandez
21. El Paso Interreligious Sponsoring Organization	Teodora Trujillo
22. El Paso League of Women Voters	Inga Groff
23. El Paso Restaurant Association	Ben Arriola
24. Environmental Defense Fund	Dr. Carlon Rincon

25. Fort Bliss	Elza Cushing
26. Greater El Paso Association of Realtors	Sonia Burgener
27. Greater El Paso Chamber of Commerce	Laura Uribarri
28. International Garment Processors	Ignacio Macias
29. JPMorgan Chase	Bob Snow
30. Mayfield Pool Supply	Alex Barrio
31. Paso del Norte Health Foundation	Ann Pauli
32. Region 19 Head Start Program	Blanca Enriquez
33. Socorro Independent School District	Rafael Padilla
34. Southern Union Gas	Pete Parraz
35. Texas A&M Research Center	Dr. Kenneth Marcum
36. Texas Parks & Wildlife	Lois Balin
37. University of Texas at El Paso	Dr. Paul Maxwell
38. Wells Fargo Bank	Steve Helbing Giselle Smith
39. West Texas Irrigation Association	Lewis Wright
40. Winton Pools	Engle Southard
41. YWCA	Tracy Yellen
42. Ysleta Independent School District	Fred Gatewood Doug Littlejohn
43. At Large	Dave Hall Kevin Von Finger

RESOLUTION

RESOLUTION APPROVING AMENDMENTS TO THE EL PASO DROUGHT AND WATER EMERGENCY MANAGEMENT RESPONSE PLAN PURSUANT TO THE RECOMMENDATIONS OF THE EL PASO WATER UTILITIES PUBLIC SERVICE BOARD AND THE EL PASO WATER UTILITIES CITIZENS PUBLIC WORKING COMMITTEE.

WHEREAS, the El Paso City Council by Resolution of September 4, 2002, declared that Stage 1 drought conservation methods contained in the Drought and Water Emergency Management Response Plan, Title 15, Chapter 15.13.140 of the City Water Conservation Code be adopted and implemented effective September 9, 2002, for the City of El Paso; and,

WHEREAS, said Resolution also directed that the response actions for Stages 1, 2 and 3 of the Drought and Water Emergency Management Response Plan be sent to the El Paso Water Utilities citizens Public Working Committee for review and recommended changes; and,

WHEREAS, the Public Working Committee met several times in October 2002, to review the stages and prepare recommended changes and the Public Service Board approved the Public Working Committee's Report at its November 13, 2002, meeting; **NOW THEREFORE,**

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF EL PASO, TEXAS THAT:

The Amendments to the Drought and Water Emergency Management Response Plan, attached hereto as Exhibit "A" are hereby approved.

ADOPTED AND EFFECTIVE this 13th day of February, 2003

CITY OF EL PASO

Raymond C. Caballero, Mayor

ATTEST:

Richard Duffy Momsen, City Clerk

APPROVED AS TO FORM:

Rita Rodriguez, City Attorney

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RESOLUTION

A RESOLUTION PURSUANT TO THE CITY DROUGHT AND WATER EMERGENCY MANAGEMENT RESPONSE PLAN, CHAPTER 15.13 WATER CONSERVATION ORDINANCE, DECLARING STAGE 2 WATER RESTRICTIONS BE IMPOSED EFFECTIVE APRIL 1, 2003, AND REVISING STAGE 2 WATER RESTRICTIONS BY ADDING NUMBER 18 TO PROVIDE THAT LARGE HOUSING COMPLEXES SHALL BE ALLOWED ADDITIONAL TIME TO WATER ON THEIR DESIGNATED DAY, ON A CASE-BY-CASE BASIS BY PERMIT, TO BE APPROVED BY THE EL PASO WATER UTILITIES WATER CONSERVATION DEPARTMENT.

WHEREAS, the City Council, by Resolution dated September 4, 2002, declared a drought condition affecting the City of El Paso and adopted Stage 1 drought response management conditions effective September 9, 2002, for the City until such time as the PSB reported back to the City Council on drought conditions; and,

WHEREAS, by Resolution dated February 13, 2003, the El Paso City Council approved and adopted amendments to the Drought and Water Emergency Management Response Plan as codified at Chapter 15.13, Water Conservation Ordinance; and,

WHEREAS, the General Manager of the El Paso Water Utilities reported to the El Paso Water Utilities Public Service Board (PSB) at its regular meeting, February 26, 2003, the severity of a drought condition affecting the upper and middle Rio Grande; and,

WHEREAS, the PSB, by Resolution dated February 26, 2003, recommends and requests the City Council authorize the imposition of Stage 2 water restrictions effective April 1, 2003; and,

WHEREAS, the PSB, by minute order March 12, 2003, agreed that apartment complexes and large turf water users could water under a special permit issued by the El Paso Water Utilities with target reduction goals set by the El Paso Water Utilities; and,

WHEREAS, the PSB will continue to monitor drought conditions and promptly recommend to the City Council when Stage 2 water restrictions should be rescinded or modified as warranted by changing conditions; and,

WHEREAS, the City Council does not wish for the El Paso Water Utilities to implement surcharges.

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF EL PASO THAT:

Pursuant to the City Water Conservation Ordinance, the City Council hereby declares that due to drought, Stage 2 water restrictions are in effect April 1, 2003. A listing of said methods is attached hereto as Exhibit "A" and made a part hereof by this reference for all purposes.

Stage 2 water restrictions is hereby revised by adding number 18 to provide that apartment complexes and large turf water users shall water in accordance with a special permit issued by El Paso Water Utilities and will reduce consumption based on reduction targets set by El Paso Water Utilities.

Stage 2 water restrictions shall remain in effect until June 17, 2003; thereafter, Stage 1 water restrictions shall resume.

ADOPTED AND EFFECTIVE the 18th day of March, 2003.

THE CITY OF EL PASO

Raymond C. Caballero, Mayor

ATTEST:

Richarda Duffy Momsen, City Clerk

APPROVED AS TO FORM:

Rita Rodriguez, City Attorney

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STAGE 2

All Stage 1 response options remain in effect.
Additionally:

1. Outdoor watering will be limited to once per week as per the following schedule. Watering will occur before 9:00 a.m. and after 7:00 p.m. and shall be limited to two hours per day. The last number of the street address shall determine watering days.

Watering Schedule

Day of Week	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Last # of Address	-	0	1,3	2,4	5	6,8	7,9

(Outdoor watering performed with a permanent drip irrigation system, sub-surface irrigation, or reclaimed water is exempt. Using a bucket to water trees, shrubs and flowers is permitted. Using household greywater is encouraged.)

2. Parks and schools served by El Paso Water Utilities shall water in accordance with a special permit issued by El Paso Water Utilities and will reduce consumption by a specific amount per month based on reduction targets set by EPWU to meet basic demand. (Parks and schools irrigating with reclaimed water are exempt.)
3. Golf courses irrigating with potable water supplied by El Paso Water Utilities and municipal golf courses shall water in accordance with a special permit issued by El Paso Water Utilities and will reduce consumption by a specific amount per month based on reduction targets set by EPWU to meet basic demand. (Golf courses irrigating with reclaimed water are exempt.)
4. Water used to provide for the health, safety and welfare of the El Paso Zoo animals is not subject to the water emergency responses listed herein. Zoo water requirements will be as determined by the Zoo Director.
5. Nurseries shall water plant stock in accordance with a special permit issued by El Paso Water Utilities.
6. No new landscaping shall be installed or planted and no new landscape watering permits will be issued except for Xeriscapes which are drip irrigated using a permanent system, use subsurface irrigation, or are irrigated with reclaimed water. New landscaping watering permits shall be granted for a 7-day period for landscaping that incorporates compost in the area at a rate of 5 cubic yards per 1000 square feet of turf.
7. All evaporative cooler continuous bleed-off lines shall be disconnected or replaced with an automatic water drainage system.

8. All water conservation ordinance variances are automatically suspended and no new variances will be issued.
9. Routine fire hydrant flushing and testing shall be curtailed.
10. Existing swimming pools cannot be drained and filled with potable water supplied by El Paso Water Utilities after April 1. Single-family residential swimming pools must be covered when not in use. Pools can be topped off to replace water loss by evaporation.
11. Upon a second violation of the Drought and Water Emergency Management Response Plan, the General Manager may order the installation of a restriction device or downsizing of the water meter at the customer's cost.
12. Restaurants shall serve water only on request.
13. Misters shall not be operated, except by special permit for health and safety reasons.
14. Water can be used for aesthetic purposes, such as ornamental fountains, in accordance with a special permit issued by El Paso Water Utilities.
15. Impervious surface cleaning with potable water shall be prohibited, except where conducted by order of the City-County Health and Environmental District or the Police and/or Fire Department.
16. Hotels and motels must implement water conservation measures, including the reduction of laundry water usage.
17. A drought surcharge may be added to water rates.
18. Apartment complexes and large turf water users shall water in accordance with a special permit issued by El Paso Water Utilities and will reduce consumption based on reduction targets set by El Paso Water Utilities.

Any of the above measures may be implemented as warranted.

RESOLUTION

A RESOLUTION AMENDING THE CITY DROUGHT AND WATER EMERGENCY MANAGEMENT RESPONSE PLAN, REVISING STAGE 2 WATER RESTRICTIONS NUMBER 7 TO PROVIDE THAT ALL EVAPORATIVE COOLERS THAT REQUIRE A BLEED-OFF SYSTEM MUST HAVE A RESTRICTED BLEED-OFF LINE OR AN AUTOMATIC WATER DRAINAGE SYSTEM.

WHEREAS, the City Council at its regular meeting Tuesday, March 25, 2003, approved receiving a Resolution for action to amend Drought and Water Emergency Management Response Plan Stage 2 Drought Restrictions number 7 which currently provides that all evaporative cooler continuous bleed-off lines be disconnected or replaced with an automatic water drainage system; and,

WHEREAS, the new replacement language for Stage 2 Drought Restrictions number 7 is to be that all evaporative coolers that require a bleed-off system must have a restricted bleed-off line or an automatic drainage system; **NOW, THEREFORE,**

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF EL PASO THAT:

Drought and Water Emergency Management Response Plan Stage 2 restrictions, number 7 is hereby changed to read as follows: "7. All evaporative coolers that require a bleed-off system must have a restricted bleed-off line or an automatic drainage system."

ADOPTED AND EFFECTIVE this 8th day of April, 2003.

THE CITY OF EL PASO

Raymond C. Caballero
Mayor

ATTEST:

Richarda Duffy Momsen
City Clerk

APPROVED AS TO FORM:

Rita Rodriguez
City Attorney

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DOC#90923/Water Y34.

APPENDIX C. WATER UTILITY PROFILE

TEXAS WATER DEVELOPMENT BOARD

UTILITY PROFILE

The purpose of the Utility Profile is to assist with water conservation plan development and to ensure that important information and data be considered when preparing your water conservation plan and its target and goals. Please complete all questions as completely and objectively as possible. See *Water Conservation Plan Guidance Checklist* (WRD-022) for information on other water conservation provisions. You may contact the Municipal Water Conservation Unit of the TWDB at 512-936-2391 for assistance.

APPLICANT DATA

Name of Utility: El Paso Water Utilities – Public Service Board

Address & Zip: 1154 Hawkins, El Paso TX 79925

Telephone Number: (915) 594-5614 Fax: (915) 594-5699

Form Completed By: Marcela Navarrete Title: Chief Financial Officer

Signature: Marcela Navarrete Date: 7/20/09

Name and Phone Number of Person/Department responsible for implementing a water conservation program:

Name: Marcela Navarrete, Chief Financial Officer Phone: (915) 594-5614

UTILITY DATA

I. CUSTOMER DATA

A. Population and Service Area Data

1. Please attach a copy of your Certificate of Convenience and Necessity (CCN) from the TCEQ

   Please see Attachment A

2. Service area size (square miles): 250 square miles

3. Current population of service area:______742,062

4. Current population served by utility:
   a: water: 200,061 accounts, including wholesale customers
   b: wastewater: 185,082 accounts, including wholesale customers

5. Population served by water utility for the previous five years:

Year	Population
2004___	703,437
2005____	709,992
2006____	722,458
2007	729,969
2008__	742,062

6. Projected population for service area in the following decades:

Year	Population
2010	768,130_
2020	892,235_
2030	1,019,504
2040	1,248,609
2050	1,370,012

7. List source(s)/method(s) for the calculation of current and projected population:
   Years 2004 – 2030 were obtained from the Border Region Modeling Project at the University of Texas at El Paso. Figures for 2040 and 2050 were obtained from the Far West Texas Regional Growth Plan for Region E, May 2006.

B. Active Connections

1. Current number of active connections by user type. If not a separate classification, check whether multi-family service is counted as Residential _____ or Commercial _____

Treated Water Users	Metered	Not-Metered	Total
Residential Single Family[1]	163,016	0	163,016
Residential Multi-family	2,125	0	2,125
Commercial	12,159	0	12,159
Industrial	169	0	169
Public	2,807	0	1,807
Other[2]	17,830	0	17,830

[1]Figures are as of Feb 2009, residential single family includes duplex and triplex
[2] Includes churches, schools, and wholesale customer accounts.

2. List the net number of new connections per year for most recent three years:

New Connections	March '06-Feb'07	March '07- Feb '08	March '08- Feb '09
Residential Single Family[1]	3,902	2,988	2,542
Residential Multi-family	(18)	(2)	22
Commercial	336	250	1,448[3]
Industrial	(3)	(5)	(16)
Public	(22)	92	69
Other[2]	1,112	347	531

[1]Figures are as of Feb 2009, residential single family includes duplex and triplex
[2] Includes churches, schools, and wholesale customer accounts.
[3] Increase mostly due to large adjustment recognizing construction meters.

C. High Volume Customers

List annual water use for the five highest volume retail and wholesale customers (Please indicate if treated or raw water delivery.)

	Customer	Use (1,000gal./yr.)	indicate Treated **OR** Raw
1)	Lower Valley Water District	1,637,180	Treated
2)	City of El Paso	1,375,737	Treated
3)	El Paso Electric Company	904,364	Treated
4)	El Paso County	904,048	Treated
5)	El Paso Independent School District	464,498	Treated

II. WATER USE DATA FOR SERVICE AREA

A. Water Accounting Data

1. Amount of water use for previous five years (in 1,000 gal.):
   Please indicate: **Diverted Water** X

CY	2004	2005	2006	2007	2008
January	2,151,754	2,006,717	2,141,343	2,003,043	2,171,493
February	2,078,505	1,718,669	2,031,247	1,918,533	2,174,756
March	2,546,463	2,311,832	2,629,952	2,721,752	2,803,043
April	2,696,039	2,912,659	3,248,297	3,051,657	3,155,253
May	3,658,902	3,531,187	3,978,804	3,358,849	3,700,290
June	4,012,279	4,164,506	4,339,596	3,915,217	4,305,814
July	4,019,984	4,459,241	3,964,462	3,910,211	3,391,763
August	3,563,389	3,553,442	3,161,056	3,850,154	3,283,807
September	3,234,279	3,362,396	2,877,648	3,403,261	2,960,028
October	2,546,103	2,685,899	2,693,586	3,085,963	2,834,759
November	2,101,120	2,344,293	2,323,467	2,256,677	2,363,034
December	2,039,718	2,121,911	2,067,566	2,160,768	2,175,243
Total	34,648,535	35,172,753	35,457,024	35,636,084	35,319,284

Please indicate how the above figures were determined (e.g., from a master meter located at the point of a diversion from a stream or located at a point where raw water enters the treatment plant, or from water sales).
Figures were obtained by daily water production reports produced by the Water Production Division of the El Paso Water Utilities..

2. Amount of water (in 1,000 gallons) delivered (sold) as recorded by the following account types (See #1, Appendix A) for the past five years.

	Residential	Commercial	Industrial	Wholesale	Other	Total Sold
2004	21,421,802	7,029,928	1,163,501	2,035,974	390,870	32,042,075
2005	21,640,482	7,254,847	1,115,484	2,133,041	420,940	32,564,794
2006	21,340,932	7,584,034	1,184,905	2,101,320	383,771	32,594,962
2007	21,387,308	7,611,663	958,434	2,244,286	430,596	32,632,287
2008	20,692,110	7,789,947	993,675	2,275,105	798,867	32,549,704

3. List previous five years records for water loss (See #2, Appendix A)

Year	Amount (gal.)
2004	2,621,000
2005	2,610,000
2006	2,862,000
2007	2,972,000
2008	3,250,000

4. List previous five years records for annual peak-to-average daily use ratio (See #3, Appendix A)

Year	Average MGD	Peak MGD	Ratio
2004	95.0	156.4	1.65
2005	96.4	162.3	1.68
2006	97.0	162.7	1.68
2007	97.5	154.8	1.59
2008	96.4	158.7	1.65

5. Total per capita water use for previous five years (See #4, Appendix A):

Year	Population[3]	Total Diverted (or Treated Less Wholesale Sales (1,000 gal.)	Per Capita (gpcd)
2004	668,265.15	32,627,026	133.8
2005	674,492.40	32,529,959	132.1
2006	686,335.10	32,561,680	130.0
2007	693,470.55	32,418,714	128.1
2008	704,958.90	32,387,895	125.9

[3] Retail population only based on 95% of El Paso County population estimates from U.S. Census.

6. Seasonal water use for the previous five years (**in gallons per person per day**) (See #5, Appendix A):

Year	Population[3]	Base Per Capita Use	Summer Per Capita Use
2004	668,265	104.2	192.8
2005	674,492	96.3	200.6
2006	686,335	101.0	185.6
2007	693,471	97.5	187.1
2008	704,959	102.8	173.1

[3] Retail population only based on 95% of El Paso County population estimates from U.S. Census.

B. Projected Water Demands

Project water supply requirements for at least the next ten years using population trends, historical water use, and economic growth, etc. Indicate sources of data and how projected water demands were determined.
Attach additional sheets if necessary.

See Attachment B

III. WATER SUPPLY SYSTEM

A. Water Supply Sources

List all current water supply sources and the amounts available with each:

	Source	Amount Available
Surface Water:	_Rio Grande______________________	100__MGD
Groundwater:	Hueco & Mesilla Bolson	232.5_MGD
Contracts:	EPWU has third party agreements with the El Paso County Water Improvement District #1, U.S. Bureau of Reclamation that allows for purchase of additional surface water when necessary.	
Other:	______________________________	_____________MGD

B. Treatment and Distribution System

1. Design daily capacity of system: ____332.5 (max) MGD

2. Storage Capacity: Elevated __188.6______ MGD, Ground __25.3_____ MGD

3. If surface water, do you recycle filter backwash to the head of the plant?
Yes _X_____ No ______. If yes, approximately 2.9 ________ MGD.

4. Please describe the water system. Include the number of treatment plants, wells, and storage tanks. If possible, include a sketch of the system layout.

See Attachment C

IV. WASTEWATER UTILITY SYSTEM

A. Wastewater System Data

1. Design capacity of wastewater treatment plant(s): ____94.2_______ MGD

2. Is treated effluent used for irrigation on-site _yes____, off-site __yes___, plant washdown __yes___, or chlorination/dechlorination __no____?

   Approximately _98.013 MG per month. Could this be substituted for potable water now being used in these areas ___yes______?

3. Briefly describe the wastewater system(s) of the area serviced by the water utility. Describe how treated wastewater is disposed of. Where applicable, identify treatment plant(s) with the TCEQ name and number, the operator, owner, and, if wastewater is discharged, the receiving stream. Please provide a sketch or map which locates the plant(s) and discharge points or disposal sites.

   See attachment D

B. Wastewater Data for Service Area

1. Percent of water service area served by wastewater system: _99_%

2. Monthly volume treated for previous three years (in 1,000 gallons):

Year	2006	2007	2008
January	1,674,008	1,707,475	1,721,479
February	1,510,862	1,554,185	1,613,940
March	1,682,252	1,687,984	1,717,804
April	1,673,624	1,663,522	1,688,763
May	1,783,302	1,772,496	1,786,152
June	1,751,863	1,785,786	1,759,791
July	1,880,492	1,888,037	1,955,781
August	2,141,114	1,914,406	1,950,192
September	1,916,727	1,843,144	1,835,547
October	1,812,105	1,837,258	1,783,948
November	1,704,483	1,734,518	1,698,233
December	1,721,476	1,775,272	1,740,626
Total	21,252,308	21,164,083	21,252,256

Appendix A

Definitions of Utility Profile Terms

1. **Residential** sales should include water sold to residential (Single and Multi-Family) class customers only.
   Industrial sales should include water sold to manufacturing and other heavy industry.
   Commercial sales should include water sold to all retail businesses, offices, hospitals, etc
   Wholesale sales should include water sold to another utility for a resale to the public for human consumption.

2. **Water Loss** is the difference between water a utility purchases or produces and the amount of water that it can account for in sales and other known uses for a given period. Water loss can result from:

   1. inaccurate or incomplete record keeping;
   2. meter error;
   3. unmetered uses such as firefighting, line flushing, and water for public buildings and water treatment plants;
   4. leaks; and
   5. water theft and unauthorized use.

3. The **peak-day to average-day ratio** is calculated by dividing the maximum daily pumpage (in million gallons per day) by the average daily pumpage. Average daily pumpage is the total pumpage for the year (as reported in Section IIA1, p. 4) divided by 365 and expressed in million gallons per day.

4. **Total use in gallons per capita per day** is defined as total average daily amount of water diverted or pumped for treatment for potable use by a public water supply system. The calculation is made by dividing the water diverted or pumped for treatment for potable use by population served, then dividing by 365. Indirect reuse volumes shall be credited against total diversion volumes for the purpose of calculation gallons per capita per day for targets and goals developed for the water conservation plan. Total water use is calculated by subtracting the wholesale sales from the total water diverted or treated (as reported in Section IIA1).

5. **Seasonal water use** is the difference between base (winter) daily per capita use and summer daily per capita use. To calculate **the base daily per capita use**, average the monthly diversions for December, January, and February, and divide this average by 30. Then divide this figure by the population. To calculate the **summer daily per capita use**, use the months of June, July, and August.

Texas Commission On Environmental Quality

By These Presents Be It Known To All That

El Paso Water Utilities Public Service Board

having duly applied for certification to provide water utility service for the convenience and necessity of the public, and it having been determined by this commission that the public convenience and necessity would in fact be advanced by the provision of such service by this Applicant, is entitled to and is hereby granted this

Certificate of Convenience and Necessity No. 10211

to provide continuous and adequate water utility service to that service area or those service areas in El Paso County as by final Order or Orders duly entered by this Commission, which Order or Orders resulting from Application No. 35471-C is on file at the Commission offices in Austin, Texas; and are matters of official record available for public inspection; and be it known further that these presents do evidence the authority and the duty of El Paso Water Utilities Public Service Board to provide such utility service in accordance with the laws of this State and Rules of this Commission, subject only to any power and responsibility of this Commission to revoke or amend this Certificate in whole or in part upon a subsequent showing that the public convenience and necessity would be better served thereby.

Issued at Austin, Texas, this JUL 30 2008

For the Commission

Attachment B

Projected Water Demands

Water conservation efforts in El Paso have helped protect an important resource, as well as the economic future of the region. Aggregate consumption per customer is forecast to improve further during the next 20 years. Lower overall per capita demand levels are expected to continue.

The El Paso Water Utilities / Public Service Board is the designated regional water and wastewater planner for El Paso County. The conservation goal for El Paso County is to maintain a level below 140 gpcd, The table below illustrates the savings due to additional conservation measures in the amount of 29,349 AF /yr by 2010 and 29,148 AF/ yr by 2020. The conservation goal of 140 gpcd will further reduce the projected demands in El Paso County by 23,437 by 2060.

	2000	2010	2020	2030	2040	2050	2060
Supplied by EPWU							
Population	617,100	714,375	823,104	918,534	1,000,838	1,083,142	1,165,446
TWDB Demand (AF/yr)	133,015	148,594	168,397	183,586	197,214	211,942	228,330
Reuse (AF/yr)	5,000	7,387	10,531	13,676	16,820	19,964	23,109
Net Demand (AF/yr)	128,015	141,207	157,866	169,910	180,394	191,978	205,221
Net Per Capita Use (gpcd)	185	177	171	165	161	158	157
Per Capita Goal (gpcd)	N/A	140	140	140	140	140	140
Savings Due to Conservation (gpcd)	0	37	31	25	21	18	17
Savings Due to Additional Conservation EPWU (AF/yr)	*0*	*29,207*	*28,845*	*25,825*	*23,495*	*22,082*	*22,516*
Savings for Remainder of County (AF/yr)							
Savings Due to Conservation Fort Bliss (AF/yr)	*0*	*152*	*303*	*454*	*605*	*755*	*921*
TOTAL CONSERVATION SAVINGS (AF/yr)	**0**	**29,359**	**29,148**	**26,279**	**24,100**	**22,837**	**23,437**

Robertson-Umbenhauer Water Treatment Plants

The Robertson Plant began operations in 1943 with a 20 MGD capacity. The Umbenhauer Plant was later added in 1967, also with a 20 MGD capacity. Together, these two plants are called the Canal Street **Water Treatment Plant (WTP)**, and they use conventional treatment technology to purify Rio Grande surface water during the peak season (typically February to October, when water is released from Elephant Butte Dam to serve downstream users). The plants can be utilized during the non-irrigation season to blend and treat water pumped from wells. The Canal WTP provides water to central and west El Paso. A major infrastructure renovation was completed in 2004 on these plants that will extend the life of these facilities well into the future. This included the installation of an Ultraviolet Light disinfection system for a portion of the water leaving the plant. Major electrical upgrades were also completed in 2006.

Jonathan Rogers Water Treatment Plant

This plant, operational in 1993, was expanded to a total capacity of 60 MGD in 2002. The Utility received a $14.906 million **Environmental Protection Agency (EPA)** grant through the **Border Environmental Cooperation Commission (BECC)** and the **North American Development Bank (NADBank)** for this project, which expanded the plant's surface water treatment capacity by 50%. The grant represents approximately 40% of the cost of the total project. The expanded plant, along with a major new distribution line, went online in May 2002.

In addition to the two surface water treatment plants, the Utility's distribution system includes over 73 reservoirs, 209 boosters, 53 booster stations, over 8,500 fire hydrants, and over 2,300 miles of water lines of various sizes, up to 60 inches in diameter. The Utility must operate and maintain the entire system 24 hours a day, seven days a week, 365 days a year. While infrastructure failures do occur, the Utility ranks among the most reliable in the world. The median number of main breaks as reported by the **American Water Works Association (AWWA)** is one per every 4.2 miles of water line. EPWU averages one per every 16.08 miles of water lines—that's four times as good! Finally, the Utility has as a part of its system over 182 operational wells.

Upper Valley Water Treatment Plant and other Arsenic Facilities

In 2005 El Paso Water Utilities began operating four treatment plants specifically designed to achieve compliance with EPA's new **maximum contaminant level (MCL)** for arsenic which became effective on January 23, 2006. The four plants have a combined treatment capacity of 41 MGD which results in 96 MGD blended water meeting the MCL. The largest of the four plants is the 30 MGD Upper Valley Water Treatment Plant which uses conventional flocculation/sedimentation/filtration to remove arsenic. The remaining three plants have a combined capacity of 11 MGD and use a granular iron media to absorb arsenic.

WATER QUALITY

Currently, both surface water and ground water treated by the Utility are monitored and the quality is reported to required public regulatory agencies. Both the EPA and the **Texas Commission on Environmental Quality (TCEQ)** have hundreds of standards for quality and reporting which must be met every day. Other governmental agencies with which the Utility must work closely include the **United States Geological Survey (USGS)**, the **International Boundary and Water Commission (IBWC)**, the Rio Grande Compact Commission, the Department of the Interior's Bureau of Reclamation, and BECC—to name just a few.

El Paso Water Utilities has a long history of awards for compliance in meeting or exceeding standards set forth by the **Safe Drinking Water Act (SDWA)** and other regulatory legislation at the state, federal, and even international level. Since 2004, the Canal and the Jonathan Rogers Water Treatment Plants have been awarded the Partnership for Safe Water Phase III Directors Award. EPWU sends an annual drinking water report to all of its customers in compliance with the EPA's Consumer Confidence Rule. The report describes the Utility's water content with respect to SDWA standards. It is printed in both English and Spanish and mailed to all customers on an annual basis. The Utility must test on a regular basis for many parameters including inorganic compounds, metals, microbiological organisms, synthetic organic chemicals, and volatile organic compounds and report the results to the TCEQ and EPA. Because the Utility, without exception, meets or exceeds all quality requirements and transmits this quality potable water to its customers in a reliable manner, the TCEQ has again recognized the Utility as a "Superior Water System," the highest such designation a Utility can earn in the State of Texas.

Attachment D
Wastewater System

HASKELL R. STREET WASTEWATER TREATMENT PLANT

The oldest wastewater facility in El Paso, it was built in 1923. It has since undergone several expansions and upgrades, including a $22,000,000 upgrade to improve effluent quality and operational efficiencies at the plant, completed in 1999. This plant has won and continues to win awards for perfect compliance with regulatory permit requirements from the **National Association of Clean Water Agencies (NACWA)**. Through 2008, the plant has received 11 NACWA Gold Awards for perfect permit compliance. In 2004, the plant received the NACWA Platinum Award for five consecutive years of perfect permit compliance, and in 2007 the plant received the Platinum Eight Award for eight consecutive years of perfect compliance. In 1994, it was selected as the Texas State and USEPA Region VI winner of the Operations and Maintenance Excellence Award, Large Advanced Plant Category. It has been selling its reclaimed water to the Ascarate Municipal Golf Course for nearly 40 years, and will see its reclaimed water capabilities expanded in phases through the next several years.

Northwest Wastewater Treatment Plant

Serving the west side of the Franklin Mountains into the Upper Valley, this plant began operations in 1987 and has since been expanded to its current 17.5 MGD of treatment capacity. Highly treated effluent is either safely discharged into the Rio Grande or transmitted through the Northwest Reclaimed Water Distribution System. With significant Bureau of Reclamation and State of Texas funding assistance, the Northwest Reclaimed System serves Coronado Country Club Golf Course and various parks and schools in west El Paso providing additional, significant savings to the potable water supply. This plant has been nominated for six EPA Operations and Maintenance Excellence Awards, and in 2008 received 1st Place in the National Clean Water Act Recognition Awards for Operations and Maintenance Excellence in the Large Advanced Plant category. It has received nine NACWA Gold Awards for perfect permit compliance through 2002. In 2003, the plant received the NACWA Platinum Award for having received five consecutive Gold Awards. In 2008, the plant received the Platinum Nine Award for ten consecutive years of perfect permit compliance. In 1992, the plant and its personnel were also recognized for their commitment to safety by being awarded the Water Environment Federation's George W. Burke Award for Safety. In 2008, the plant also received the Texas State, Regional and National winner of the Clean Water Act O&M Awards Program in the Large Advanced Category.

ROBERTO R. BUSTAMANTE WASTEWATER TREATMENT PLANT

The newest plant in the system, it began operating in 1991 with a 39 MGD capacity. Using traditional technology for treatment, it—along with its neighboring Jonathan Rogers WTP—serves east El Paso. This plant has been honored by NACWA for its perfect compliance as well. Since the plant's inception and through 2007, it has received 15 NACWA Gold Awards. In 2002, the plant was one of 17 Platinum Award recipients in the nation for five consecutive years of perfect permit compliance. In 1994, the plant received second place in the national USEPA Operations and Maintenance Excellence Awards. In 2005, the plant won the Water Environment Association of Texas Plant of the Year Award. Effluent is discharged into either the Riverside Canal or Riverside

Drain for use downstream. A new large-scale reclaimed water project (online in 1998) with two million gallons per day of capacity, also serves the immediate area. The Utility has begun improvements to the plant that will lead to an eventual 14 MGD treatment capacity expansion to serve continued growth in the area.

FRED HERVEY WATER RECLAMATION PLANT

This 10 MGD plant has won not only awards, but also worldwide attention. The plant is essentially a combined water and wastewater treatment plant, which treats wastewater to drinking water quality standards. The treated effluent from this plant is sold to El Paso Electric Company for cooling water, to the nationally renowned Painted Dunes Desert Golf Course for irrigation, and the remainder replenishes the Hueco Bolson through a series of injection wells and several groundwater recharge infiltration basins. Tours are regularly provided to industry, utility, and academic representatives as one of the model plants of the system. The plant became operational in 1985 and was significantly financed with EPA assistance. The plant is also a crucial part of the EPWU plan to reduce dependence on groundwater and was featured on the internationally acclaimed PBS series "Water: The Drop of Life". The plant has received numerous awards including: the 1994 AMSA Public Information and Education Award; second place in the 1994 national USEPA Operations and Maintenance Excellence Award, No Discharge category; and the 1998 American Water Works Association's Conservation and Reuse Award. In 1999, the plant received special recognition by the El Paso del Norte Region Mission Possible-Survival Strategies in the category "Protection and Preservation of the Environment." The plant has received the NACWA Gold Award for perfect permit compliance under the expanded NACWA Peak Performance Award program in 2006, 2007 and 2008.

The Utility also operates and maintains 75 lift stations and over 2,083 miles of collection lines to keep the sewer system running at peak reliability and meet customer demand.

APPENDIX D. REPORT OF MAJOR ACCOMPLISHMENTS FOR WATER CONSERVATION

1989-90

- Reduce Summer Peak Demand with implementation of water odd/even schedule program.
- Initiated demonstration project with Texas A&M Research Center and Keep El Paso Beautiful to demonstrate water conservation type landscaping. Several sites around El Paso were Xeriscaped as demonstration gardens.

1990-91

- Water Conservation Advisory Committee developed comprehensive water conservation plan and recommended to employ a water conservation manager.

1991-92

- Water Conservation Department is formed with a total of five full time employees. A Manager, two Conservation Technicians, one Graphics designer and a Clerk Typist.
- Initiated public education campaign to include monthly messages on the back of the water bill, printed brochures and inserts and television spots.
- Received the following award:
  - 1992, Special Project Award from Keep El Paso Beautiful for Water Conservation Education.

1992-93

- Assumed enforcement of the water conservation ordinance.
- Implemented "Cash for your Commode Toilet Rebate Program" 3,600 units the first year.
- Expanded water conservation public education campaign by participating in several community events.
- Initiation of a three-year grant "Water Smart" program in cooperation with the Texas Agricultural Extension Service to increase awareness of landscape water use and appreciation of the Chihuahuan desert.

1993-94

- Expanded conservation program to hire three additional full time employees. Two Enforcement Inspectors and one Clerk Typist.
- Water conservation programs submitted by large water users were reviewed and customers contacted for progress report.
- Initiated Plant "Water Smart" Program with the Nursery Association. Banner, ID tags and printed materials were distributed to area nurseries.
- Assisted in drafting the Landscape Ordinance with City Planning Department.
- Assisted in water use survey to determine water issues awareness level.
- Received the following award:
  - Texas Section AWWA Conservation/Reuse Award, Direct program in a small utility. "Cash for your Commode" rebate program.

1994-95

- Continue enforce the city's conservation ordinance.
- Initiated free irrigation water audit program.
- Continue toilet rebate.
- Aggressive mass media education campaign.
- Education programs to schools. Willie mascot visits.
- Received the following award:
    - Watermark Award for "Nothing takes the place of water" newspaper insert.

1995-96

- Identified local government yard meter accounts monthly allocation basis.
- Invited Municipal Court Judges for a conservation forum.
- A total of 72 Willie presentations to schools.
- Continue with education campaign.
- Continue toilet rebate

1996-97

- Presented Amy Vickers report to the Public Service Board.
- Organized Water Conservation and Reuse Committee to redirect the conservation program.
- Increase the number of toilet appointments from 50 to 56 a week.
- Conducted 28 Willie presentations reaching 2,736 students.
- Provided 72 additional conservation presentations reaching 5,413 customers.
- Participated in six citywide education programs reaching 31,945 attendees.
- Increase number of citations from 118 to 128 and reduced warnings from 699 to 309.

1997-98

- Finalize Water Conservation and Reuse Advisory Committee meetings and presented committees' overall recommendations to the Public Service Board.
- Obtained a $25,000 grant from the Bureau of Reclamation to develop a bilingual water smart landscape CD-ROM with information about plants for urban landscapes located in the Chihuahuan Desert along with conservation information, regional resources and efficient horticultural techniques for the El Paso, Las Cruces and Cd. Juárez area. The project was coordinated with NMSU, UTEP, Texas Agricultural Extension Service and the Texas Urban Forest Service.
- Develop program with local Car Wash Association to curtail water waste from fund-raising car wash events. The program is called "Let's Do It Right" and allows groups to collaborate with participating commercial car wash establishments to hold fund raising non-profit events.
- Coordinated a pilot program in cooperation with El Paso Electric Company. The program called "Be Water Wise and Energy Efficient" teaches middle school students the importance of energy and water conservation. A total of 600 middle school students participated in the first year.
- Launched effective television media campaign to increase awareness of conservation.
- Increase number of citations by 274% for violations to the conservation ordinance.
- A rate modification for yard meters other than local government accounts was implemented to eliminate AWC calculation and charging Block 2 rates for yard meter consumption.

1998-99

- Finalized development of the Desert Blooms CDROM, a project partially funded by the Bureau of Reclamation. Presented final product to the Public Service Board during their monthly meeting.

- Developed a marketing campaign for the preliminary introduction and distribution of the Desert Blooms project and continued implementation of conservation focused television campaign.
- Participated as speaker for:
    - Texas Water Conservation and Irrigation Conference in Houston, TX. With "El Paso's Enforcement Program – Water Cops."
    - 3rd. Annual Water Conservation Conference in Las Cruces, NM.
- Received the following awards:
    - 1998 AWWA Water Mark Award for Communication Excellence for the "Willie's World Activity Book."
    - Honorable mention from AWWA for the main lobby mural and new brochure depicting the "El Paso Water Utilities System" under the large utility miscellaneous category.
- Organized the first El Paso's "Tree Conference" and landscape workshop for professional and homeowners for the most up-to-date information on tree care and water conservation in your landscape. Project done in cooperation with UTEP and the Texas Agricultural Extension and Research Center (300 attendees)
- Completed training of conservation staff in regards to irrigation systems water audits, educational presentations, ground water model demonstrations and vignettes with "Willie" the mascot.

1999-00

- Introduced "Desert Blooms" CDROM to the public through a comprehensive media and promotional campaign.
- Received the following awards:
    - 1889-99 American Advertising Award "Best of Show" for the best interactive media category.
    - 1999 AWWA Water Mark award for the best use of technology.
    - 1999 AWWA Conservation and Reuse, under large utility indirect category.
    - 1999 AWWA Water Mark award for "How your water is treated brochure"
    - 1999 Texas Urban Forestry "Community Forestry Award"
    - 1999 Most Creative Costume award from Hospice of El Paso. A table promoting the toilet rebate program.
- Implemented the second "Be Water Wise and Energy Efficient" program in cooperation with El Paso Electric and additional sponsorship from "Partners in Education" was secured to underwrite an additional 600 students. Completed evaluation of program showed that 1,400 households program to date showed a 12% water use reduction.
- Continued implementation of television campaign aimed at reducing water use and increase awareness of regional water issues.
- Received recognition from the League of Women Voters during their 1999 Mission Possible conference for EPWU "Protection and Preservation of the Environment" educational efforts.
- Participated as speaker for:
    - Low Desert Xeriscape Conference in Tucson AZ. With "Desert Blooms, a SunScape Guide to Plants for a Water-scarce Region".
    - Spring and Fall SunScape series at UTEP, a seven-week comprehensive Xeriscape workshop.
    - Spring and Fall Texas Agricultural Extension Master Gardener program series.
- Secured a $10,000 grant from the Bureau of Reclamation to develop a SunScape Landscape printed brochure to be used in conjunction with "Desert Blooms".
- Organized the second annual "Tree Conference" in El Paso.
- Organized and completed the first ever Bi-national, Tri-state, Tri-city "Water Festival" in cooperation with NMSU, Bureau of Reclamation, EPA, WERC and other environmental agencies

a total of 12,000 students from Cd. Juárez, Las Cruces and El Paso participated in the three day event.

- Participated in the EPWU's Public Working Committee (PWC) to gain insight and input into plans for phase II water conservation program initiatives. Participated in the preparation of the final report to the PSB.
- Obtained $20,000 from UTEP CERM program to work on a water sustainability information campaign to increase appreciation of the Chihuahuan desert.

2000-01

- Implemented PWC phase II recommendations:
  - "Showerhead Replacement Program". 200,000 showerheads were distributed to El Paso Water Utilities customers during FY 2000-01
  - Initiated the Join Water Conservation Initiative Program for Horizontal A-xis Washing Machines and Refrigerated Air Conditioner program in cooperation with El Paso Electric and El Paso Water Utilities.
  - Hired temporary enforcement during the summer of 2000
  - Hired Water Conservation Education Specialist to help lead and coordinated all educational events.
- Participated as speaker for:
  - Nursery and Landscape Exposition in Dallas, TX. With "Effectiveness of El Paso's Water Conservation Program."
  - Water Conservation in Landscape Irrigation Conference in Houston, TX. With "A City Gets Tough with Water Wasters".
  - Conservation Forum in Salt Lake City, UT. With "El Paso Water Utilities Water Conservation Program in a Water Scarce Region."
  - Spring and Fall SunScape series at UTEP.
  - Spring and Fall Texas Agricultural Extension Master Gardener program series for Texas and New Mexico.
- Implemented 3rd. "Be Water Wise and Energy Efficient" program. Funds from El Paso's Independent School District were secured for an additional 300 middle school students.
- Organized and completed the second "Water Festival" and the 3rd. "Tree Conference" in El Paso. Both festival and conference are major educational events reaching more than 15,000 citizens.
- Received the following awards:
  - 2000 AWWA Water Mark award for the "Bi-national, Tri-state, Tri-city Water Festival" under the educational campaign.
  - 2000 AWWA Water Mark award for the "Willie's Bingo" an interactive board game for children.
  - 2000 Texas Section AWWA Conservation/Reuse Award Direct Program for a Large Utility for the EPWU Showerhead Campaign.
- Continued implementation of television campaign aimed at reducing water use and increase awareness of regional water issues.

2001-02

- Implemented PWC phase III conservation initiatives:
  - "Turf Rebate Pilot Program" a PWC recommendation under conservation phase III initiatives. A total of 138 sites participated in the pilot program removing 269,343 sq. ft. of grass. An evaluation of the pilot program was conducted under a contract with the Stratus Company.
  - "Evaporative Bleed-off Clamp" program. More than 20,000 clamps were distributed to

EPWU customers during FY 2001-02
    - Amended the Water Conservation Ordinance to allow fundraising carwash events only at commercial carwash establishments and to limit grass amount on new residential homes and commercial properties.
    - Initiated the "Waterless Urinals Pilot Program" with El Paso, Ysleta and Socorro school districts. A total of 30 units were installed at different school sites.
- Continued implementation of the JWCI with El Paso Electric. A total of 301 washing machines and 428 refrigeration unit rebates were processed.
- Participated as speaker for:
    - Conferencia Internacional de Conservación de Agua in Madrid Spain with "Programa de Conservación en la ciudad de El Paso, Texas."
- Organized and completed the 3rd. "Water Festival" (12,000 attendees) and the forth "Tree Conference" (500 attendees).
- Participated with educational booths at the Home and Garden Show (11,000 attendees) and the Generation 2000 (45,000 attendees) youth events at the Civic Center.
- Continued implementation of television campaign aimed at reducing water use and increase awareness of regional water issues.
- Received the following awards:
    - 2001 Public Relation Society of America (RIA) award for "Showerhead Program Campaign" and for the "Appreciation of the Chihuahuan Desert" television spots funded by UTEP-CERM.
    - 2002 Home and Garden Show, Best Home Service Display
    - 2002 AWWA Watermark award. Miscellaneous category for the EPWU water bottle
    - 2002 ADDY Gold Award for the graphic design of the EPWU water bottle
- Worked with the El Paso International Airport in the design of water efficient landscape areas around the airport terminals.
- Remodeled EPWU main building landscape to reflect a more efficient design in a commercial setting utilizing plants that are adapted or native to our desert environment.

2002-03

- Continued implementation of all conservation initiatives: 350 turf sites, 674 refrigeration units, 759 washing machines, 2,708 toilet rebates. 10,000 clamps and 29,526 showerheads were distributed.
- Coordinated installation of landscape and plumbing fixtures on a Parade of Homes "Water Smart" home. Requested donations totaled more than $40,000 for this project. Donations included plants, gravel, irrigation system, landscape fabric, landscape design and volunteer hours from Master Gardeners who helped instruct the public regarding water efficiency in the landscape.
- Amended the Conservation Ordinance regarding drought conditions.
- Received the following awards:
  - 2002 ADDY, Advertising Federation of El Paso, Out-of-Home-Fleet Graphic. For the design of the vinyl wrap for the El Paso Water Utilities van. The van transports staff and Willie the mascot to area schools.
- Participated as speaker for:
  - 2002 American Planning Association Planning with Borders, not Boundaries conference in El Paso, TX. With "Water, a Diamond in the Desert".
  - Spring SunScape series at UTEP.
  - Fall Texas Agricultural Extension Master Gardener program.
- Organized and completed the 4th. "Water Festival" (8,000 attendees) and the 5th. "Tree Conference" (300 attendees).
- Participated in the Home and Garden Show.
- Coordinated, with El Paso Car Wash Association, the creation and airing of a television spot to promote the use of commercial car wash establishments.
- Coordinated Green Industry breakfast to initiate a public campaign promoting low-water use plants. Initiated Ms. Tree television campaign.
- Design and produced educational materials for Region XIX Head Start Program to be used at the Intellizeum. Materials included giant puzzles, memory card game, bags, coloring magnets and the water cycle interactive exhibit.
- Participated in the brainstorming session for the new Water Resource Learning Center at the planned Ft. Bliss/EPWU desalination plant.

2003-04

- Continued implementation of all conservation initiatives: 1,250 turf sites, 1,218 refrigeration units, 1,655 washing machines, 3,374 toilet rebates. 10,000 clamps and 30,101 showerheads were distributed.
- Successfully coordinated and implemented Stage One and Two of the EPWU drought and Water Emergency Management Response Plan approved by the PWC and City Council, including the supervision of the call-in center and additional temporary enforcement staff.
- Completed revision of educational materials to include drought information.
- Continue working with Region 19 Head Start Program to develop three giant lenticular murals depicting the Chihuahuan desert, regional water resources and water uses for the Intellizeum. Participated in the Head Start General Audit where the El Paso program received outstanding grades.
- Worked with the Junior League in the development of the Xeriscape demonstration garden for the Keystone Desert Botanical Garden. Active member of the educational committee for the park. Worked with Junior League members to request funds from the EPWU-PSB.
- Appointed to the Water Conservation Implementation Task force set for by the 78th Texas Legislature.
- Participated and implemented in the development of new EPWU/WIT project initiatives such as

subsurface irrigation and hot water on demand pilot programs.

- Participated as speaker for:
  - 2004 Water Sources Conference in Austin, TX. With "Savings from a Turf Rebate Program in the Chihuahuan desert".
  - 2004 Rotary International RYLA conference in Cd. Juárez, Mexico. With "El Paso's Water Utilities Conservation Program."
- Received the following award:
  - 2003 AWWA Water Mark award for the work done at the "Intellizeum Head Start Region 19."

2004-05

- Appointed as Project Manager to work with selected firm in the development of the educational exhibits planned for the $TecH_20$ Center.
- Implemented the newest conservation initiatives recommended by the PWC and approved by the Public Service Board, the Hot Water on Demand pilot program, the Refrigeration Rebate for Builders and the Clothes Washing Machine Rebate for commercial establishments and the Waterless Urinal pilot program.
- Actively worked and participated with the City's new committee "Green Sweep" an initiative to promote the benefits of trees in urban environments.
- Secure a grant from the Texas Forest Service for a total of $14,000 for the development and production of rotating billboards promoting the benefits obtained from planting water efficient trees in El Paso.
- Worked with the City's Streets and Parks Department to establish a tree farm in the Lower Valley to use reclaimed water and to grow water efficient trees for future city and Utility landscape projects.
- Partnered with the El Paso Zoo to include $50,000 for the installation of ozonation filtration systems, shade structures for the public and for educational collaboration between the Zoo Education Program and the utility's conservation department.
- Collaborated with the El Paso Electric in an education program to bring a newly developed program to local schools. The program includes water and energy conservation kits and curriculum for teachers, students and their families. A total of 1,371 middle school students and their teachers participated in the program.
- Received the following awards:
  - 2005 Education Excellence Public Education Award and the Exemplary Service Award for improving public awareness of the importance of water and the water utilities industry by the Texas Water Utilities Association.
  - 2005 First place for most creative costume, Hospice of El Paso. Promotion of the Clothes Washing Machines Rebate program

2005-06

- Received the following awards:
  - 2006 AWWA Watermark award. Audio and visual category for "Water is Life" television campaign
  - 2006 Hospice of El Paso, best table setting to El Paso Water Utilities
- Worked with marketing consultant hired by the Texas Water Development Board to conduct a focus group in El Paso to measure conservation knowledge as part of the continued work of the State Conservation Task Force.
- Initiated the first ever Water Week student essay contest for 6^{th} to 12^{th} grade school students; 51 entries were judged by staff

- Actively worked and participated with the organization of the first ever Chihuahuan Desert Education Coalition (CDEC) and its first “Chihuahuan Desert Fiesta” held at Tom Mays Park.
- Participated as speaker, sponsored, and assisted in organization of the first International Conference on the Environmental and Human Health (ICEHH) at the Camino Real Hotel.
- Developed and organized the El Paso Water and Energy Conservation (EPWEC) program. This regional program promotes water and energy conservation awareness in the El Paso del Norte Region. A total of 1,371 middle school students and teachers participated in this program.

2006-07

- Coordinated implementation of the Keystone Botanical Garden Education Series. A total of 4 session designed to promote the garden and conservation efforts by the Utility. One session was designed for teachers to increase awareness of the many agencies, members of the Chihuahuan Desert Education Coalition that can provide environmental education and presentations to area schools.
- Collaborated with the El Paso Zoo Education Department by helping train new zoo volunteers and docents.
- Organized second annual Chihuahuan Desert Education Coalition “Desert Fiesta” Over 500 adults took part of this celebration.
- Implemented the “Willie Wrench Program” a leak detection and assistance program for low-income customers. The conservation department also monitored the consumption patterns of subsurface irrigation systems installed at one public school and area residents.

2007-08

- Organized the move and the grand opening of the Carlos M. Ramirez TecH_20 Water Resources Learning Center. The state-of-the-art facility includes 16 theme-exhibits to highlighting total water management in the Chihuahuan Desert.

2008-09

- Contracted teachers to develop curriculum activities based on TEKS and the center’s exhibit. A total of 13 lesson plans were develop and included on our webpage.
- Finalized Girl Scouts conservation patch program
- Trained volunteers donated a total of 1,150 hours while working as docents for the center.
- Implemented five Teacher Educational Workshops, including the first Texas certified Project Webfoot Wetland curriculum workshop. 640 credit hours were credited to participating teachers.
- Organized the Region E Water Conservation Conference as a requirement under a grant from the Rio Grande Council of Governments; 150 participants from neighboring counties came to the conference.
- Received the AWWA-Texas Section and the Water Environment Association of Texas. Miscellaneous for the TecH_20 Center.

APPENDIX 6B

EL PASO WATER COUNTY WATER IMPROVEMENT

DISTRICT NO. 1

WATER CONSERVATION PLAN

El Paso County Water Improvement District No. 1

Water Conservation Plan

Prepared for

Texas Commission on Environmental Quality

State of Texas – Austin, Texas

January 2010

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APPENDICES

DISCLAIMER

The amount of water available to the District depends, in part, on the amount of runoff from snow melt in the Rio Grande Watershed in Southern Colorado and Northern New Mexico. The determination of when the District is subject to drought is made on a case-by-case basis at the sole discretion of the District Board of Directors. This plan does not constitute a contract or an agreement and may be changed from time-to-time by the District's Board of Directors. A copy of this plan was provided to the Chair of the Far West Texas Water Planning Group.

1 Introduction and Overview

El Paso County Water Improvement District No. 1 (the District) is a reclamation and conservation district organized under Article 16, Section 56 of the Texas Constitution and operates under federal reclamation law and under Chapter 49 and Chapter 55 of the Texas Water Code. The District is part of the United States Bureau of Reclamation Rio Grande Project that extends from the headwaters of Elephant Butte Reservoir in New Mexico to Ft. Quitman, Texas approximately 75 miles southeast of the City of El Paso. The Rio Grande Project is operated under federal reclamation and state water laws in accordance with federal water supply contracts, the Rio Grande Compact, and the Treaty of 1906 between the United States and the Republic of Mexico. This water conservation plan was developed in accordance with the requirements of Title 30 of the Texas Administrative Code, Chapter 288, as effective on January 3, 2010.

2 System Inventory

Appendix A contains a detailed map of the facilities of the Rio Grande Project. Appendix B contains a list of each delivery and drainage canal. The District's facilities are located in both New Mexico and El Paso County, Texas.

2.1 Storage and Diversion Dams

The Rio Grande Project has one major storage reservoir with approximately 2 million acre-feet of storage capacity (Elephant Butte Reservoir near Truth or Consequences, New Mexico), and one combined storage/flood reservoir (Caballo Reservoir north of Hatch, New Mexico) with approximately 0.2 million acres-feet of storage capacity and 0.50 million acre-feet of flood storage capacity. The Project has five diversion dams located on the Rio Grande. Below Caballo reservoir, the first two diversion dams are Percha and Leaseburg, which are located in New Mexico and exclusively serve irrigated land in that state. The third diversion dam is Mesilla, located south of Las Cruces, New Mexico and which serves land in both New Mexico and Texas. The fourth diversion dam, the American, is located in Texas near the intersection of the boundaries between New Mexico, Texas, and Mexico, and is the primary diversion dam for the District. The fifth diversion dam, the International, exclusively diverts water for Mexico under the provisions of the Treaty of 1906.

2.2 Irrigation Canal Systems

Land within the District is served by seven major irrigation canal systems (70 miles) and dozens of smaller lateral canals with a combined length of approximately 257 miles. The major irrigation canal systems are:

La Union East

La Union West

American and American Canal Extension

Franklin and Franklin Canal Extension

Riverside and Riverside Canal Extension

Tornillo

2.3 Agricultural Drainage System

Land within the District is served by nine major drainage canal systems and dozens of smaller lateral canals with a combined length of approximately 283 miles. The major drainage canal systems are:

Nemexas

Borderland

Montoya

Mesa

Middle

Playa

Franklin

Island

Tornillo

2.4 Maintenance and Operations Yards

The District has four maintenance and operation yards located in Canutillo, Ysleta, Clint, and Fabens, Texas.

3 Management Practices

3.1 Operating Rules and Regulations

The District is governed by statutory requirements of Chapter 49, in part, and Chapter 55 of the Texas Water Code and applicable sections of the Texas Local Government Code, Tax Code, Government Code, and other codes, provisions and requirements of contracts between the District and the United States, and applicable provisions of Title 43 of the United States Code.

3.2 Land Assessments and Water Delivery Charges

In accordance with Chapter 55.354 of the Texas Water Code, the District determines its assessments in arrears and as necessary to meet operation and maintenance expense.

3.3 Practices and Devices Used to Account for Water Deliveries

The District measures the amount of water delivered through each farm turnout using open channel velocity meters (Price AA meters) for normal water levels in the supply canal. The meter notes are used to determine a rating table for each metering location. The average flow rate values for each turn-out are kept in the water order data base and used to determine the amount of water charged for each irrigation.

The District meters approximately 50 delivery system sites and has telemetry and water level recorders at approximately 40 sites. Figure 1 shows a typical metering site. Figures 2, 3 and 4 show, respectively, a typical telemetry system, flow equation calibration chart, and hydrograph from an actual metering site.

Figure 1 – Open Channel Meter Bridge

Figure 2 – Typical Telemetry Site Equipment

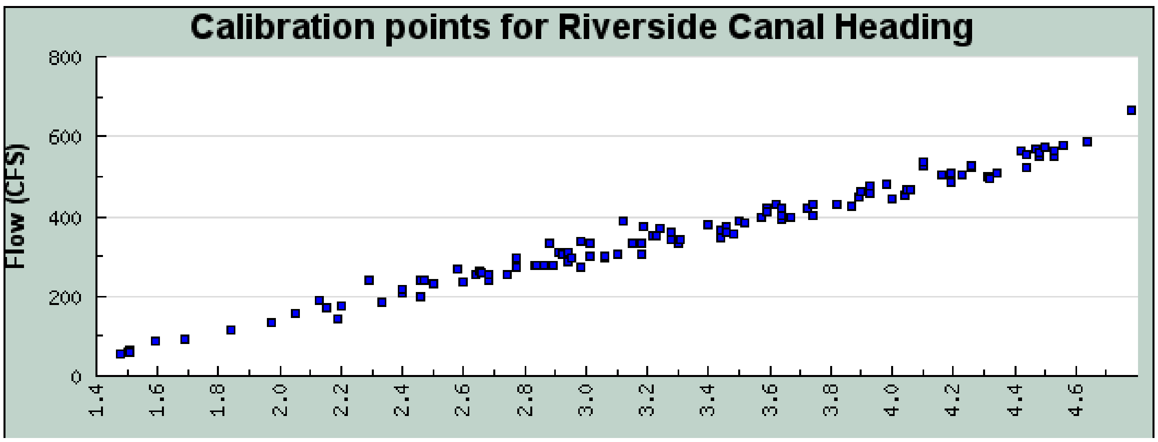

Figure 3 – Typical Calibration Chart

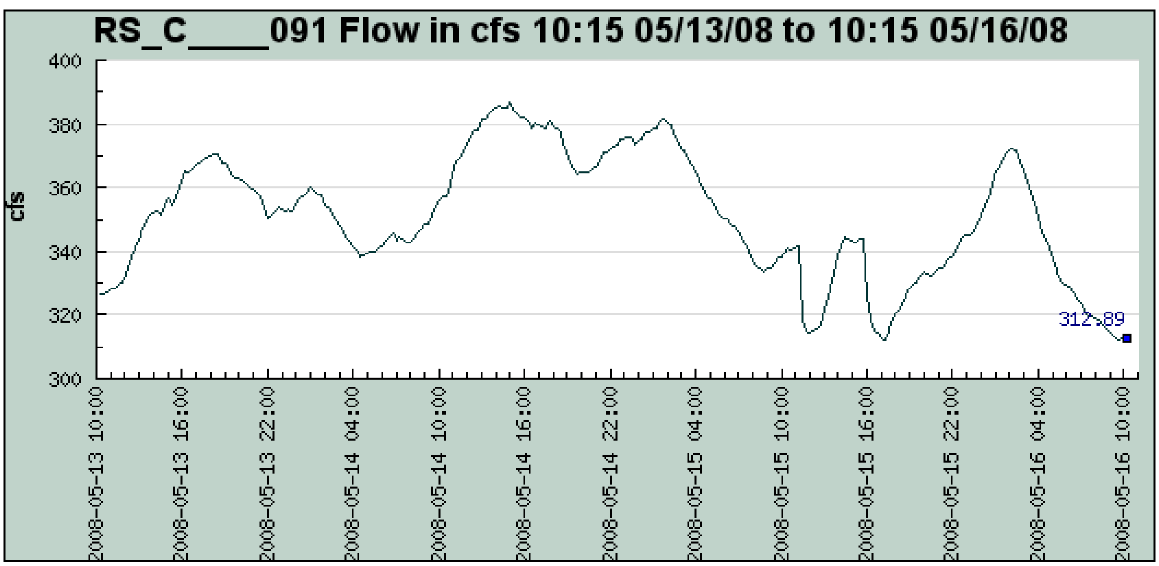

Figure 4 – Typical Hydrograph

4 Water User Profile

4.1 Area served

The District has approximately 99,840 acres (156 square miles) within its boundaries, of which 69,010 acres are classified as irrigable.

4.2 Number of Water Users

The District has approximately 3,000 water users. The majority of these users are owners of small tracts of land (less than 2 acres) that use the water for landscape irrigation. The owners of approximately 12,000 acres of irrigable land have assigned their right to Project water to either the Lower Valley Water District or the City of El Paso.

4.3 Types of Crops

The primary crops grown in El Paso County are pima cotton, pecans, alfalfa, corn, wheat, onions, and chiles. Small quantities of other fruits and vegetables are grown for local markets. Table 1 shows the amount of land and crop type that was planted in 2008.

El Paso County Water Improvement District No. 1 Permit 1584

Year	Crop and Land Ues	Months Irrigated	Acres*
2008	Wheat / Barley / Oats	Dec-Jun	106
	Alfalfa Hay	Mar-Oct	3,139
	Sudan and Other Hay	Mar-Oct	245
	Pasture	Jan-Dec	619
	Corn Silage/Sorgum/Forage	Mar-Sep	762
	Cotton (Upland and Pima)	Feb-Sep	20,682
	Other	Jan-Dec	17
	Cabbage and Lettuce	Feb-May	17
	Corn (Sweet)	Apr-Aug	11
	Onions	Jan-Dec	638
	Peppers	Feb-Sep	345
	Grapes	Apr-Sep	0
	Pecans	Jan-Oct	10,829
	Idle Land because of Drought or Rotation*	Jan-Dec	8,500
	Assigned or Converted to M&I Use	Jan-Dec	11,786
	Family Gardens/Orchards/Lawns	Mar-Oct	3,422
	Idle Land*	Jan-Dec	7,892
	Total		69,010

Table 1 – 2008 Crop Acreage

4.4 Types of Irrigation Systems

Because of water quality issues, historically all land is irrigated by flood irrigation. During the winter of 2006, a 30 acre commercial agricultural plot of land was irrigated using surface drip tape and water from an irrigation well. Because Rio Grande project water contains a significant amount of sediment and, at times, salt no drip irrigation projects using Project water have ever been commercially successful.

4.5 Types of Drainage Systems

The primary drainage system is open cut canals. A small portion of these canals have been buried to provide for surface uses (City Park) or prevent trash dumping (San Elizario drain). Additional drains are being evaluated for subsurface placement. A small amount of agricultural farm land uses drain tile.

4.6 Irrigable and Irrigated Acreage

The District has a total of 69,010 acres of irrigable land. As mentioned above, the rights to Project water on approximately 12,000 acres has been assigned to either the Lower Valley Water District or the City of El Paso. Agricultural production accounts for 45,000 acres, with the remaining acreage either being irrigated landscape or not irrigated.

5 Water Savings, Losses, and Diversions

5.1 Quantified 5-Year and 10-Year Targets for Water Saving

The District took over operation of its canals from the United States in 1980. Prior to 1980 the average district efficiency (ratio of farm deliveries to river diversions) was approximately 54%. Currently the district efficiency ranges from 65% to 73% depending on the total amount of water available for diversion. The District has ongoing canal lining and pipeline program, however because of the large cost to line canals (the District's large canals cost $1 to $3 million per mile) it is not economically feasible to increase the delivery efficiency above 80%. A significant portion of the water flowing into El Paso County is return flow or treated sewage effluent and has been used previously by upstream water users. All of the water that flows out of the District into Hudspeth County is used to irrigate land in Hudspeth County. When the combined efficiency of all water users and reuse is considered the overall project efficiency is greater than 95%, and during drought approaches 100%.

Table 1 below lists the ongoing conservation projects, the estimated time of completion and the estimated water savings. The District has very limited sources of revenue and currently cannot fund the majority of the proposed projects listed in Table 2. The District is seeking both federal and state assistance in constructing the proposed projects and the actual completion date for each project is dependent on receiving funding on a timely basis.

Table 2 – Planned Water Conservation Projects

Project	Start	Finish	Cost	Savings
	Date	Date	$	ac-ft/yr
5 Year Projects				
Phase I - Riverside Canal - Partidor	2009	2010	$ 1,300,000	100
Various Pipeline Projects	2010	2015	$ 750,000	225
Misc. EPDM Lining Projects	2010	2015	$ 200,000	125
Automatic Gates and Telemetry	2010	2015	$ 500,000	750
				1,200
10 Year Goal Projects				
Phase I - Riverside Canal Lining Project	2010	2020	$ 7,000,000	3,600
Phase II - Riverside Canal Lining Project	2015	2020	$ 14,000,000	4,300
Misc. EPDM Lining Projects	2015	2020	$ 500,000	250
Pipeline Projects	2015	2020	$ 1,500,000	450
Regulating Reservoir	2015	2020	$ 9,000,000	6,500
Automatic Gates and Telemetry	2015	2020	$ 1,000,000	1,500
				16,600

5.2 Maximum Allowable Losses for Storage and Distribution System

The maximum allowable loss has not been quantified because the storage system is in New Mexico and is under the control of the federal government. The distribution system includes many canals and over 75 miles of river in New Mexico which are not under the control of the District.

6 Measurements of Diversions from the Rio Grande

All measurement of diversions from the Rio Grande are controlled by the United States Government and are measured using flow meters or USGS stream gauging methods (see Section 3.3 above).

7 Conservation Programs

7.1 Monitoring and Record Management

Water delivery records are kept for each of the district's approximately 3,000 water user accounts. Because of the uniqueness of the administration of the irrigable land and the contractual rights regarding delivery of irrigation water, the District has developed a custom record management and tax assessment system. The data base is used to generate annual and monthly water use statements to all water users.

7.2 Leak Detection, Repair, and Water Loss Control

The district irrigation canals are patrolled 24 hours a day – 7 days a week during the primary irrigation season (typically from March 15 to October 15). Any failure or leaks from the delivery system are reported to the District's dispatch office, and depending on the size and impact of the leak, repair crews may be dispatched immediately to repair the leak or a work order is generated to schedule the repair.

7.3 On-farm Water Conservation and Pollution Prevention

The District promotes on-farm water conservation information through its semi-annual newsletter. To minimize pollution from storm water runoff, the District does not allow any storm water to be discharged in any irrigation or drainage canals except during emergency floods or as allowed under TPDES permits held by the City of El Paso.

8 Water Supply Contracts

All water supply contracts for Project water require the approval of the United States. The District has entered in to a number of contracts that allow the City of El Paso and the Lower Valley Water District to receive Rio Grande Project water. These contracts make available raw non-potable irrigation water from the District's irrigation canals. The District Certificate of Adjudication of Water Rights, attached as Appendix C, contains information regarding the District's contractual and other rights to divert water from the Rio Grande.

9 Adoption of the Water Conservation Plan

This plan was adopted by the District Board of Director by resolution on January 13, 2010 and remains in effect, unless otherwise changed, until January 13, 2015.

10 Coordination with the Regional Water Planning Group

Nothing in this water conservation plan conflicts with the Far West Texas Regional Water Plan. A copy of this plan was provided to the Far West Texas Regional Water Planning Group. The General Manager of the District is a member of the Group and the District has provided input and documentation to the Group regarding best management practices for agricultural water conservation in El Paso County.

Appendix A – Map of the Rio Grande Project

(Map to large to include in this document)

Appendix B – Table of Lengths of Irrigation Delivery and Drain System Canals

Profile ID	Name	Also Known As	Type	Length	Valley	(notes)
C1	Canutillo		Irrigation Canal	246+92	Lower	
C2	Franklin		Irrigation Canal	1623+83	Lower	
C3	Franklin Feeder		Irrigation Canal	142+30	Lower	
C4	Hudspeth Feeder #1		Irrigation Canal		Lower	HCCRD
C5	Hudspeth		Irrigation Canal		Lower	HCCRD
C6	Island Main		Irrigation Canal	206+89	Lower	
C7	Island Feeder		Irrigation Canal	106+90	Lower	
C8	La Union East	La Union	Irrigation Canal		Upper	see L51
C9	Riverside		Irrigation Canal	587+00	Lower	
C10	Riverside Extension		Irrigation Canal		Lower	
C11	Southside Feeder		Irrigation Canal	150+48	Lower	
C12	Tornillo		Irrigation Canal	632+42	Lower	
L1	Alfalfa		Irrigation Lateral Canal	21+12	Lower	
L2	Baker		Irrigation Lateral Canal	213+60	Lower	
L3	Barrial		Irrigation Lateral Canal	70+75	Lower	
L4	Bernal		Irrigation Lateral Canal	73+39	Lower	
L5	Bovee		Irrigation Lateral Canal	49+52	Lower	
L6	Bowman		Irrigation Lateral Canal	64+10	Lower	
L7	Canas Agrias		Irrigation Lateral Canal	105+03	Lower	
L8	Canutillo		Irrigation Lateral Canal	231+26	Lower	
L9	Cinecue		Irrigation Lateral Canal	38+23	Lower	
L10	Clint Extention		Irrigation Lateral Canal	33+26	Lower	
L11	Clint		Irrigation Lateral Canal	391+68	Lower	
L12	Coffin		Irrigation Lateral Canal	36+00	Lower	
L13	Cook-Shultz		Irrigation Lateral Canal	12+67	Lower	
L14	Crismore	S-379	Irrigation Lateral Canal	84+99	Lower	
L15	Cuadrilla		Irrigation Lateral Canal	99+84	Lower	
L16	Coles	C-1	Irrigation Lateral Canal			unknown
L17	Daughtery		Irrigation Lateral Canal	166+72	Lower	
L18	Del Monte		Irrigation Lateral Canal	33+79	Lower	
L19	Y-147	De Groff	Irrigation Lateral Canal	89+23	Lower	
L20	Ellis		Irrigation Lateral Canal	59+33	Lower	
L21	Escajeda		Irrigation Lateral Canal	12+14	Lower	
L22	Farm Detention		Irrigation Lateral Canal		Lower	End of Three Saints East
L23	Farm Spillway		Irrigation Lateral Canal		Lower	End of Three Saints East
L24	Glardon		Irrigation Lateral Canal	18+28	Lower	
L25	Grandview		Irrigation Lateral Canal	33+13	Lower	
L26	Green		Irrigation Lateral Canal	78+48	Lower	
L27	Guadalupe		Irrigation Lateral Canal	296+62	Lower	
L27	Guadalupe Extension		Irrigation Lateral Canal	28+89	Lower	
L28	Guadalupe Intercepting		Irrigation Lateral Canal	27+98	Lower	
L29	Hall		Irrigation Lateral Canal	19+89	Lower	
L30	Hansen		Irrigation Lateral Canal	271+70	Lower	
L31	Highbank		Irrigation Lateral Canal		Lower	unknown
L32	Hansen Feeder		Irrigation Lateral Canal		Lower	unknown
L33	I-72		Irrigation Lateral Canal	34+76	Lower	
L34	I-136		Irrigation Lateral Canal	50+00	Lower	
L35	I-154		Irrigation Lateral Canal	230+15	Lower	

Profile ID	Name	Also Known As	Type	Length	Valley	(notes)
L36	I-206		Irrigation Lateral Canal	121+83	Lower	
L37	I-207		Irrigation Lateral Canal		Lower	
L38	I-243		Irrigation Lateral Canal	151+32	Lower	
L39	I-270		Irrigation Lateral Canal	57+88	Lower	
L40	I-341		Irrigation Lateral Canal	199+92	Lower	
L41	Island Feeder		Irrigation Lateral Canal	108+15	Lower	
	IF-57		Irrigation Lateral Canal		Lower	
L42	Irwin		Irrigation Lateral Canal	23+76	Lower	
L43	Island Main		Irrigation Lateral Canal	206+89	Lower	
L44	I-Zero	Island	Irrigation Lateral Canal	41+16	Lower	
L45	Jornado		Irrigation Lateral Canal	151+38	Lower	
L46	Juan de Herrera		Irrigation Lateral Canal		Lower	same as Juan de Herrera Main
L47	Juan de Herrera A		Irrigation Lateral Canal	165+98	Lower	
L48	Juan de Herrera B		Irrigation Lateral Canal	178+85	Lower	
L49	Juan de Herrera C		Irrigation Lateral Canal	65+00	Lower	
L50	Juan de Herrera Main		Irrigation Lateral Canal	369+71	Lower	
L51	La Union	LUE	Irrigation Lateral Canal	183+91	Upper	End Sta 539+30 minus Texas border Sta 355+30
L52	La Union West		Irrigation Lateral Canal	27+15	Upper	End Sta 551+42 minus Texas borde Sta 524+27
L53	La Union Combined		Irrigation Lateral Canal		Upper	Part of LUE from Sta 473+49
L54	Lee		Irrigation Lateral Canal	23+21	Lower	
L55	Lowenstein		Irrigation Lateral Canal	36+41	Lower	
L56	Montoya Main		Irrigation Lateral Canal	314+19	Upper	
L57	Montoya A		Irrigation Lateral Canal	123+98	Upper	
L58	Montoya B		Irrigation Lateral Canal	72+86	Upper	
L59	Montoya C		Irrigation Lateral Canal	74+06	Upper	
L60	Montoya D		Irrigation Lateral Canal	106+71	Upper	
L61	Malone		Irrigation Lateral Canal	54+77	Lower	
L62	Madre		Irrigation Lateral Canal	09+34	Lower	
L63	Newman		Irrigation Lateral Canal		Lower	community ditch
L64	Northside		Irrigation Lateral Canal	31+15	Lower	
L65	Orr		Irrigation Lateral Canal		Lower	unknown
L66	Pence		Irrigation Lateral Canal	31+70	Lower	
L67	Playa		Irrigation Lateral Canal	342+09	Lower	
L68	Quemada		Irrigation Lateral Canal	51+81	Lower	
L69	River		Irrigation Lateral Canal		Lower	unknown
L70	Riverside		Irrigation Lateral Canal		Lower	
L71	Rodriguena		Irrigation Lateral Canal	135+03	Lower	
L72	Rowley		Irrigation Lateral Canal	65+15	Lower	
L73	Rio		Irrigation Lateral Canal	50+47	Lower	unknown
L74	Southside Feeder		Irrigation Lateral Canal	150+35	Lower	
L75	Southside		Irrigation Lateral Canal		Lower	aka Southside Feeder
L76	Socorro		Irrigation Lateral Canal	176+41	Lower	
L77	Stevens		Irrigation Lateral Canal	83+06	Lower	
L78	Schutz		Irrigation Lateral Canal	87+57	Lower	
L79	San Elizario		Irrigation Lateral Canal	411+88	Lower	
L80	Salitral		Irrigation Lateral Canal	607+00	Lower	

Profile ID	Name	Also Known As	Type	Length	Valley	(notes)
L81	Crismore	S-379	Irrigation Lateral Canal		Lower	redundant entry on master list
L82	Texas		Irrigation Lateral Canal	99+76	Lower	
L83	Tornillo	T-216	Irrigation Lateral Canal	283+37	Lower	
L84	T-520		Irrigation Lateral Canal	78+00	Lower	
L85	Three Saints East		Irrigation Lateral Canal		Upper	
L86	Three Saints	T.St. West	Irrigation Lateral Canal	85+03	Upper	E.B.I.D.
L87	T-131		Irrigation Lateral Canal	151+25	Lower	
L88	T-462		Irrigation Lateral Canal	17+95	Lower	
L89	T-216		Irrigation Lateral Canal	283+54	Lower	
L90	Upper Clint		Irrigation Lateral Canal	84+65	Lower	
L91	Valley Gate		Irrigation Lateral Canal	150+00	Lower	covered up
L92	Vinton		Irrigation Lateral Canal	93+42	Upper	
L93	Vinton River		Irrigation Lateral Canal		Upper	lower part of Vinton along Rio Grande
L94	Vinton Cutoff		Irrigation Lateral Canal	94+51	Upper	
L95	Wadlington		Irrigation Lateral Canal	42+69	Lower	
L96	Webb		Irrigation Lateral Canal	26+27	Lower	
L97	Y-65		Irrigation Lateral Canal	55+38	Lower	
L98	De Groff	Y-147	Irrigation Lateral Canal	87+39	Lower	redundant entry on master list
L99	Y-197		Irrigation Lateral Canal	53+78	Lower	
L100	Y-303		Irrigation Lateral Canal	58+93	Lower	
L101	Ysla		Irrigation Lateral Canal	391+45	Lower	
L102	Ysla Extension		Irrigation Lateral Canal	10+03	Lower	
L103	Y-251		Irrigation Lateral Canal	24+88	Lower	
L104	Zack		Irrigation Lateral Canal		Upper	part in Texas, most in NM
D1	Anthony		Drainage Canal	420+14	Upper	
D2	Anthony Spur		Drainage Canal		Upper	unknown
D3	Alamo Alto		Drainage Canal	507+00	Lower	
D4	Border		Drainage Canal		Lower	same as Border Intercepting
D5	Border Intercepting		Drainage Canal	586+36	Lower	
D6	Border Spur #1		Drainage Canal	141+44	Lower	
D6	Border Spur #2		Drainage Canal	51+75	Lower	
D7	Borderland Spur		Drainage Canal	162+50	Lower	
D8	Central		Drainage Canal	138+90	Lower	
D9	Central Spur		Drainage Canal	131+00	Lower	
D10	Clint Spur		Drainage Canal	60+30	Lower	
D11	Cook Intercepting		Drainage Canal	23+50	Lower	
D12	Crawford Spur		Drainage Canal	44+67	Lower	
D13	Cuadrilla Intercepting		Drainage Canal	68+90	Lower	
D14	Dolan		Drainage Canal		Lower	same as Dolan Spur
D15	Dolan Spur		Drainage Canal	122+00	Lower	
D16	Dorrough Spur		Drainage Canal		Lower	covered up
D17	Dorrough		Drainage Canal		Lower	covered up
D18	Duckett Intercepting		Drainage Canal	37+61	Upper	
D19	Duckett Spur		Drainage Canal	171+17	Upper	
D20	East		Drainage Canal	608+43	Upper	
D21	Fabens		Drainage Canal	357+66	Lower	
D22	Fabens Intercepting		Drainage Canal	101+00	Lower	

Profile ID	Name	Also Known As	Type	Length	Valley	(notes)
D23	Franklin		Drainage Canal	425+00	Lower	
D24	Franklin Intercepting		Drainage Canal	154+12	Lower	
D25	Franklin Spur		Drainage Canal	107+66	Lower	
D26	Fabens Waste Channel		Drainage Canal	361+07	Lower	
D27	Hansen Intercepting		Drainage Canal	16+00	Lower	
D28	Hansen Feeder Intercepting		Drainage Canal	69+12	Lower	
D29	Island		Drainage Canal	628+13	Lower	
D30	Island Spur		Drainage Canal	147+43	Lower	
D31	Island Farmers		Drainage Canal	41+98	Lower	
D32	Island Tornillo	I-T Siphon	Drainage Canal		Lower	part of Island
D33	I-F Island Feeder Intercepting		Drainage Canal	54+58	Lower	
D34	Island Connection		Drainage Canal		Lower	unknown
D35	Island Drain Syphon		Drainage Canal		Lower	part of Island
D36	Kelly Intercepting		Drainage Canal		Lower	unknown
D37	Lake Spur Drain		Drainage Canal	36+90	Lower	
D38	Lee Moore Intercepting		Drainage Canal	190+76	Lower	
D39	Montoya		Drainage Canal	370+80	Upper	
D40	Mesa		Drainage Canal	1166+00	Lower	
D41	Mesa Spur #1		Drainage Canal	370+63	Lower	
D41	Mesa Spur #2		Drainage Canal		Lower	part of Mesa Spur
D42	Middle		Drainage Canal	832+70	Lower	
D43	Mesa Outlet		Drainage Canal		Lower	
D44	Nemexas		Drainage Canal	992+11	Upper	
D45	Orr's Spur	Orr's	Drainage Canal		Lower	
D46	Perez Spur		Drainage Canal	25+00	Lower	
D47	Playa		Drainage Canal	726+39	Lower	
D48	Playa Intercepting		Drainage Canal	436+40	Lower	
D49	Playa Intercepting A		Drainage Canal	08+52	Lower	
	Playa Extension Drain		Drainage Canal	110+00	Lower	found blueline profile scroll - no ID
D50	River		Drainage Canal	670+00	Lower	
D51	River Outlet		Drainage Canal	94+50	Lower	
D52	River Spur		Drainage Canal	170+00	Lower	
D53	Riverside Intercepting		Drainage Canal	597+34	Lower	
D53	Riverside Extension		Drainage Canal		Lower	part of Riverside Intercepting
D54	River Spur #1		Drainage Canal		Lower	unknown
D55	Rio Intercepting		Drainage Canal	40+15	Lower	
D56	San Felipe Arroyo		Drainage Canal		Lower	county's
D57	Socorro Intercepting		Drainage Canal	86+70	Lower	
D58	Sequila Intercepting		Drainage Canal	26+00	Lower	
D59	Tornillo		Drainage Canal	441+30	Lower	
D60	Tornillo Spur		Drainage Canal	70+86	Lower	
D61	Thompson Spur		Drainage Canal		Lower	Pete says sold off
D62	Tornillo Outlet		Drainage Canal		Lower	end of Tornillo
D63	Tornillo Intercepting #1		Drainage Canal	215+20	Lower	
D63	Tornillo Intercepting #2		Drainage Canal	145+00	Lower	
D63	Tornillo Intecepting B		Drainage Canal	12+00	Lower	

Profile ID	Name	Also Known As	Type	Length	Valley	(notes)
D64	Upper Tornillo		Drainage Canal	79+78	Lower	
D65	Vinton		Drainage Canal	152+48	Upper	
D66	Vinton River		Drainage Canal		Upper	same as Vinton
D67	Valley Gate Intercepting		Drainage Canal	46+99	Lower	
D68	Valley Gate Spur		Drainage Canal	29+20	Lower	
D69	Warnock Spur		Drainage Canal		Lower	City of El Paso's
D70	West		Drainage Canal	1273+80	Upper	
	Young Spur Drain		Drainage Canal	65+39	Lower	found blueline profile scroll - no ID
W1	Ascarate		Waste Way	61+02	Lower	
W2	Bernal		Waste Way		Lower	
W3	Borderland Spur Drain		Waste Way		Lower	
W4	Crismore		Waste Way		Lower	
W5	Clint		Waste Way		Lower	
W6	Franklin Canal		Waste Way		Lower	
W7	Green		Waste Way		Lower	
W8	Granview		Waste Way		Lower	
W9	Guadalupe Extension		Waste Way		Lower	
W10	Guadalupe Intercepting		Waste Way		Lower	
W11	I-206 Island		Waste Way		Lower	
W12	I-243 Island		Waste Way		Lower	
W13	Island Feeder		Waste Way		Lower	
W14	Leon Street		Waste Way		Lower	
W15	Rodriguena		Waste Way		Lower	
W16	Riverside Canal		Waste Way		Lower	
W17	Riverside Canal Intake Structure		Waste Way		Lower	
W18	San Elizario		Waste Way		Lower	
W19	Socorro		Waste Way		Lower	
W20	Salitral		Waste Way		Lower	
W21	Tornillo	T-131	Waste Way		Lower	
W22	Tornillo Canal		Waste Way		Lower	
W23	T-520		Waste Way		Lower	
W24	Upper Clint		Waste Way		Lower	
W25	Wasteway #1		Waste Way		Lower	
W25	Wasteway #2		Waste Way		Lower	
W25	Wasteway #23		Waste Way		Upper	
W25	Wasteway #23A		Waste Way	0+82	Upper	
W25	Wasteway #32A		Waste Way		Upper	
W25	Wasteway #32B		Waste Way		Upper	
W25	Wasteway #34		Waste Way		Upper	
W25	Wasteway #35A		Waste Way		Upper	
W25	Wasteway #35C		Waste Way		Upper	
W25	Wasteway #37A		Waste Way	23+79	Upper	
W25	Wasteway #38		Waste Way		Upper	

Appendix C – Certificate of Adjudication for Water Rights

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

CERTIFICATE OF ADJUDICATION

CERTIFICATE OF ADJUDICATION NO. 23-5940

Names of Holders:	United States of America	Address:	Bureau of Reclamation 505 Marquette NW, Suite 1313 Albuquerque, NM 87102-2162
	El Paso County Water Improvement District No. 1		294 Candelaria Street El Paso, TX 79907
Priority Dates:	July 6, 1889 and January 1, 1918		
Purpose:	Agricultural, Municipal, Industrial, Mining, and/or Recreational Uses	Counties:	El Paso and Hudspeth
Watercourse:	Rio Grande (above Ft. Quitman, Texas)	Watershed:	Rio Grande Basin

WHEREAS, in 1905, the United States enacted the Rio Grande Reclamation Project Act of February 25, 1905, 33 Stat. 814, authorizing the construction of storage facilities on the Rio Grande in the Territory of New Mexico for storage of water of the Rio Grande for irrigation of lands in New Mexico and Texas for the Rio Grande Reclamation Project;

WHEREAS, in 1905, the State of Texas enacted House Bill 588, 29th Legislature, Chapter 101 (as amended, now Section 11.052 of the Texas Water Code), which authorized the Secretary of the Interior to make all necessary examinations and surveys for, and to locate and construct reclamation works for irrigation purposes within the State of Texas, and to perform any and all acts necessary to carry into effect the provisions of the Reclamation Act of 1902 (38 Stat. 388, now 43 U.S.C. § 371, *et seq.*) as to such lands, subject to all the provisions, limitations, charges, terms and conditions of the said Reclamation Act;

WHEREAS, Section 8 of the Reclamation Act of 1902 (now 43 U.S.C. §§ 372 and 383) provides in part: "Nothing in this Act shall be construed as affecting or intended to affect or to in any way interfere with the laws of any State or Territory relating to the control, appropriation, use, or distribution of water used in irrigation, or any vested right acquired thereunder, and the

Secretary of the Interior, in carrying out the provisions of this act, shall proceed in conformity with such laws, and nothing herein shall in any way affect any right of any State or of the Federal Government or of any landowner, appropriator, or user of water in, to, or from any interstate stream or the waters thereof.";

WHEREAS, in 1906, the United States entered into the Convention with Mexico for the Rio Grande providing for the equitable distribution of water of the Rio Grande for irrigation purposes (34 Stat.2953). The Convention also provides that the delivery of said amount of water to Mexico shall be assured by the United States, and shall be distributed through the year in the same proportions as the water supply furnished from said irrigation system to lands in the United States in the vicinity of El Paso, Texas, and in case of extraordinary drought or serious accident to the irrigation system in the United States, the amount delivered to Mexico at the Acequia Madre shall be diminished in the same proportion as the water delivered to lands under said irrigation system in the United States. Under Article IV of such Convention, Mexico waived any and all claims to the waters of the Rio Grande for any purpose whatever between the head of the Acequia Madre and Fort Quitman, Texas;

WHEREAS, in 1906 and 1908, pursuant to the Reclamation Act of 1902, the Reclamation Service notified the Territorial Irrigation Engineer for the Territory of New Mexico of reservations by the United States of Rio Grande water for the Rio Grande Reclamation Project in accordance with the laws of the Territory of New Mexico;

WHEREAS, in 1910, Congress approved an Act (36 Stat. 559) which enabled the people of New Mexico to form a constitution and state government and to be admitted to the Union on an equal footing with the original States. Section 2 of such Act provided in part, "that there be and are reserved to the United States, with full acquiescence of the State [New Mexico], all rights and powers for the carrying out of the provisions by the United States of an Act of Congress entitled 'An Act appropriating the receipts from the sale and disposal of public lands in certain States and Territories to the construction of irrigation works for the reclamation of arid lands' approved June seventeenth, nineteen hundred and two, and Acts amendatory thereof or supplementary thereto [43 U.S.C. § 371 *et seq.*], as to the same extent as if said State had remained a Territory";

WHEREAS, in 1911, the State of Texas adopted what is now Section 11.005, Texas Water Code, which provides as follows: "This chapter applies to the construction, maintenance, and operation of irrigation works constructed in this state under the federal reclamation act, as amended (43 U.S.C. Sec. 371 et. seq.), to the extent that this chapter is not inconsistent with the federal act or the regulations made under that act by the secretary of the interior.";

WHEREAS, the United States stores water in two reservoirs, Elephant Butte and Caballo, located in New Mexico, for use throughout the Rio Grange Reclamation Project and for delivery to Mexico. The United States releases water from such storage and supplements such released water with return flow to the Rio Grande and water in the Rio Grande from other sources, and diverts such water at a series of diversion dams on the Rio Grande in New Mexico and Texas;

WHEREAS, the United States purchased lands, canals and water rights in Texas for the construction of the Rio Grande Reclamation Project, and such purchases included, without limitation, the Franklin Canal and the lands and water rights identified in the Loomis affidavits of 1889, later embodied in Certified Filing No. 123, using Reclamation funds which were subject to reimbursement to the United States by Rio Grande Reclamation Project water users;

WHEREAS, in 1939, the United States, Colorado, New Mexico and Texas entered into the Rio Grande Compact (53 Stat. 785; Section 41.009, Texas Water Code), which constitutes statutory law of the United States and the States of Colorado, New Mexico, and Texas and by the terms of the Compact cannot be modified without the approval of all four parties to the Compact;

WHEREAS, the United States releases stored water from Elephant Butte and Caballo Reservoirs to supply water to the Elephant Butte Irrigation District in New Mexico and the El Paso County Water Improvement District No. 1 in Texas. The first two diversion dams downstream of Caballo Dam (Percha Diversion Dam and Leasburg Diversion Dam) are used by the United States to deliver water to land in New Mexico. A substantial amount of water diverted by these two diversion dams for use in New Mexico is returned to the Rio Grande for use downstream of the dams. The next downstream diversion dam is the Mesilla Diversion Dam, which is located in New Mexico but is used to divert water to both the Elephant Butte Irrigation District and the El Paso County Water Improvement District No. 1. The American Diversion Dam is the next diversion dam downstream on the Rio Grande. It is the first diversion dam in Texas, and divides water in the Rio Grande between Mexico and the United States. Water for Mexico is provided by the United States and delivered to Mexico at the International Diversion Dam, in the Rio Grande downstream of the American Diversion Dam. Water for the El Paso County Water Improvement District No. 1 is presently diverted by the United States into the American Canal at the American Diversion Dam, but for many years the United States diverted some of such water at the Riverside Diversion Dam, which is presently not functional but may be rebuilt in the future;

WHEREAS, approximately 2.3 miles downstream from the American Diversion Dam is the International Diversion Dam. The International Diversion Dam is used to provide and deliver 60,000 acre-feet of water per year to Mexico pursuant to the 1906 Convention, and is the only diversion location authorized by the 1906 Convention or any other treaty between the United States and Mexico for diversion of water from the Rio Grande upstream of Fort Quitman, Texas. The Riverside Diversion Dam is the last downstream diversion dam on the Rio Grande below Caballo Dam and upstream of Fort Quitman, Texas. The Riverside Diversion Dam is presently not functional but may be rebuilt in the future;

WHEREAS, the United States entered into a contract dated December 29,1917, with the El Paso County Water Improvement District No. 1 and the El Paso Valley Water Users' Association. Thereafter, the El Paso Valley Water Users' Association was dissolved;

WHEREAS, the El Paso County Water Improvement District No. 1 ("District") is a political subdivision of the State of Texas, organized and existing under Article XVI, Section 59 of the Texas Constitution, and is subject to Chapter 55 of the Texas Water Code and other provisions thereof. The District is authorized by statute to enter into contracts or other obligations with the United States (§ 55.185, Texas Water Code). By statute the District is required to "...distribute and apportion all water acquired by the district under a contract with the United States in accordance with acts of Congress, rules and regulations of the secretary of the interior, and provisions of the contract" (Section 55.364, Texas Water Code). The El Paso County Water Improvement District No. 1 includes 69,010 acres within its boundaries that are classified by the United States and the District as irrigable;

WHEREAS, in 1920, the El Paso County Water Improvement District No. 1 merged with the El Paso County Conservation and Reclamation District No. 2, with the merged districts thereafter known as the El Paso County Water Improvement District No. 1;

WHEREAS, in 1924, the United States entered into a contract (the "Warren Act Contract") with the Hudspeth County Conservation and Reclamation District No. 1 ("HCCRD"), pursuant to the Warren Act of 1911 (43 U.S.C. §§ 523-525), and the parties amended such contract in 1951. HCCRD holds Texas Permit No. 236 as amended by Permit No. 236A. Such permit authorizes HCCRD to divert water from the Rio Grande at two grade control structures, located at latitude 31.413 degrees north 106.096 degrees west in El Paso County, Texas and at latitude 31.318 degrees north and longitude 105.936 degrees west in Hudspeth County, Texas;

WHEREAS, in 1996, the United States conveyed to the El Paso County Water Improvement District No. 1 certain facilities and rights-of-way within the District's boundaries but reserved ownership of the American Canal, the American Canal Extension, and the American, International and Riverside Diversion Dams;

WHEREAS, pursuant to 43 U.S.C. § 521, which allows the Secretary of the Interior to authorize conversion of water used in the Rio Grande Reclamation Project from irrigation to other uses, the United States entered into contracts with the El Paso County Water Improvement District No. 1 and the City of El Paso in 1941, 1944, 1949, 1962, 1999, and 2001 for the supply of Rio Grande Reclamation Project irrigation water for municipal and industrial uses by the City. The United States, the El Paso County Water Improvement District No. 1, and the Lower Valley Water District entered into similar contracts in 1988 and 1999 pursuant to 43 U.S.C. § 521 as well;

WHEREAS, in 1991, the District applied for a permit and asserted in its application that without waiving any, and while still preserving all, of its legal and "equitable" rights under federal and state law, (including, without limitation, the Rio Grande Compact; the 1906 Water Convention, May 21, 1906, between the United States and Mexico; contracts between or among the El Paso County Water Improvement District No. 1 and other entities, including the United States and New Mexico or its agencies; the Reclamation Laws of the United States and those acquired in New Mexico by virtue of the reservation of water rights by the United States as provided by notices from the United States to the New Mexico Territorial Engineer in 1906 and 1908). The Texas Natural Resource Conservation Commission (the "Commission") recognized that the El Paso County Water Improvement District No. 1 had those rights to that portion of the facilities and water of the Rio Grande Reclamation Project and the Rio Grande and its tributaries which have been reserved for or appropriated by or for the benefit of the District and its predecessors and beneficial users or which otherwise have been provided to them by law, equity or contract;

WHEREAS, pursuant to such application, the Commission issued to the District Permit No. 5433;

WHEREAS, by final decree of the 327th Judicial District Court of El Paso County, Texas, in Cause No. 2006-3291, In Re: Adjudication of All Claims of Water Rights in the Upper Rio Grande (above Fort Quitman, Texas) Segment of the Rio Grande Basin, dated October 30, 2006, rights were recognized authorizing the United States and the El Paso County Water Improvement District No. 1 to impound, divert, and use waters of the State of Texas as set forth below.

NOW, THEREFORE, this certificate to appropriate waters of the State of Texas in the Rio Grande Basin is issued to the United States of America and the El Paso County Water Improvement District No. 1, subject to the following terms and conditions:

1. IMPOUNDMENT AND USE

   a. Certificate Holder United States is authorized to impound 2,638,860 acre-feet of water in Elephant Butte Reservoir and Caballo Reservoir in New Mexico.

   b. Certificate Holders United States and El Paso County Water Improvement District No. 1 are authorized to divert and Certificate Holder El Paso County Water Improvement District No. 1 is authorized to use an aggregate amount of water from the Rio Grande not in excess of 376,000 acre-feet per year from the following sources:

      i. all rights which Certificate Holders acquired or perfected pursuant to Certified Filing No. 123;

      ii. 67/155 of all water stored in Project Storage (as defined in the Rio Grande Compact) and legally available for release to the Elephant Butte Irrigation District and the El Paso County Water Improvement District No. 1, plus any additional share of Project Water obtained by Certificate Holders, or either of them, through allocation, purchase and/or operation rules, "Project Water" being defined as all water legally dedicated to the Rio Grande Reclamation Project;

and

iii. any waters entering Texas in the bed of the Rio Grande from New Mexico, including, but not limited to, return flows from New Mexico's use and groundwater discharged into the Rio Grande.

c. In addition to the water diverted pursuant to paragraph 1.b above, Certificate Holders are authorized to divert from the Rio Grande up to 234,022 acre-feet per year of measurable surface-water based effluent, groundwater based effluent, or groundwater discharged into the Rio Grande by the District or any other entity with whom the District has entered into legal contract for such water. "Effluent" as used in this Certificate of Adjudication means any and all water that reaches the bed of the Rio Grande from agricultural drains, sewage treatment plants, or storm water runoff.

d. In addition to the water diverted pursuant to paragraphs 1.b. and 1.c. above, Certificate Holders are authorized to divert from the Rio Grande an average of 1,899 acre-feet of water per year, when averaged over any five-year period, from tributary inflows of the Rio Grande between the Texas/New Mexico state line and the Riverside Diversion Dam.

e. Certificate Holders are authorized to use the bed and banks of the Rio Grande to transport the water which is the subject of this Certificate of Adjudication, and to operate and maintain diversion dams and works.

2. DIVERSION POINTS

a. Certificate Holders are authorized to divert all or any part of the water authorized for diversion in paragraphs 1.b and 1.c above at the following diversion points:

i. Mesilla Diversion Dam located on the Rio Grande in New Mexico;

ii. American Diversion Dam located on the Rio Grande at the point where Texas, Mexico, and New Mexico meet; and

iii. Riverside Diversion Dam located on the Rio Grande approximately 13.5 miles downstream of the American Diversion Dam;

at a combined maximum diversion rate of 1,355 cubic feet per second.

b. Certificate Holders are authorized to divert the water authorized for diversion in paragraph 1.d above, from the American Diversion Dam and the Riverside Diversion Dam at a combined maximum diversion rate of 10 cubic feet per second.

3. PURPOSE AND PLACE OF USE

Certificate Holder El Paso County Water Improvement District No. 1 is authorized to use all of the water authorized herein for agricultural, municipal, industrial, mining, or recreational purposes and/or irrigation of a maximum of 69,010 acres of land within the District's boundaries and/or to sell any of this water surplus to the District's needs for any of the authorized purposes of use in El Paso and Hudspeth Counties.

4. SPECIAL CONDITIONS

a. This Certificate of Adjudication does not supersede any legal requirement for the protection of environmental water needs pursuant to international treaty, interstate compact, or other applicable law to which Certificate Holders are subject irrespective hereof. Nothing in this condition is intended to grant to the State of Texas any authority additional to that provided by law or to waive any right of Certificate Holders.

b. This Certificate of Adjudication is not intended to in any way compromise or diminish the volume of water which the United States is obligated to provide to Mexico on an annual basis pursuant to the terms of the Convention of May 21, 1906, between the United States and Mexico; nor does the Certificate grant to the District, for any use whatsoever, any waters to which Mexico is entitled pursuant to the above referenced 1906 Convention.

c. Nothing in this Certificate of Adjudication is intended to modify any authority of the State of Texas or the United States of America provided by law, now or in the future.

5. PRIORITY

a. The time priority for use of the water included in paragraphs 1.b. and 1.c., as referenced above, is July 6, 1889.

b. The time priority for use of the water included in paragraph 1.d., as referenced above, is January 1, 1918.

The locations of pertinent features related to this Certificate of Adjudication are shown on pages 1 through 18 of the Appendix to the Report of the Investigation of Water Rights in the Upper Rio Grande (above Fort Quitman) Segment of the Rio Grande Basin, Texas. Copies of such pages are located in the office of the Texas Commission on Environmental Quality, Austin, Texas.

This Certificate of Adjudication is issued subject to all terms, conditions and provisions in the Final Decree of the 327th Judicial District Court of El Paso County, Texas, in Cause No. 2006-

3291, In Re: Adjudication of All Claims of Water Rights in the Upper Rio Grande (above Fort Quitman, Texas) Segment of the Rio Grande Basin dated October 30, 2006, and supersedes all rights of Certificates Holders asserted in that cause.

This Certificate of Adjudication is issued subject to senior and superior water rights in the Rio Grande Basin.

This Certificate of Adjudication is issued subject to the rules of the Texas Commission on Environmental Quality and its continuing right of supervision of State water resources consistent with the public policy of the State as set forth in the Texas Water Code, to the extent that such rules and supervision are not inconsistent with the federal Reclamation Act (43 U.S.C. § 371, *et seq.*) or the regulations made under that Act by the Secretary of the Interior as provided in Section 11.005 of the Texas Water Code.

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Kathleen H White

Kathleen Hartnett White, Chairman

3/7/07

Date Issued

ATTEST:

LaDonna Castañuela

LaDonna Castanuela, Chief Clerk

APPENDIX 6C

HUDSPETH COUNTY CONSERVATION AND RECLAMATION DISTRICT NO.1

WATER CONSERVATION PLAN

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Hudspeth County Conservation and Reclamation District No. 1

Mission, and General Description:

The irrigation district plan for the Hudspeth County Conservation and Reclamation District No. 1 (HCCRD No.1) was developed in November of 1991. The district occupies approximately 18,300 acres of Rio Grande River bottomlands from the El Paso/Hudspeth County line downstream to Fort Quitman. The district was created to provide adequate irrigation to those lands.

The HCCRD No.1 was organized in 1924 to consolidate water diversions from the Rio Grande. Under a Warren Act contract, the district has taken a direct diversion of the river since 1925. A board of directors governs the district, with headquarters in Fort Hancock, Texas.

Water Resources and Supply:

The district's primary source of water includes untreated water obtained 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 district's operations are primarily recycling and reuse that further the use of the waters in the Rio Grande Basin. Because the water supply to the HCCRD No.1 is totally dependent on the water supply to the EPCWID No.1, the supply is erratic, and the optimal utilization of available water is difficult.

Water Use:

All water used in the district is for irrigation. The HCCRD No.1 does not supply potable water. When ample water is available, lands in the district are quite productive. Cotton, small grains, forages, and irrigated pasture represent the principal crops.

Management of Water Supplies:

The HCCRD No.1 has constructed a system of canals, drains, and regulating reservoirs to distribute irrigation water through the district. Over the last several years, the volume of the regulating reservoirs has been expanded by 3,200 acre-ft. A program to reduce canal losses is in place.

The HCCRD No.1 taxes water-use customers on a per acre basis of irrigable land. Additional assessments are made on acres watered under percentage water conditions, in order to equate the taxes with benefits delivered. The district meters water delivered to customers. When the supply of water exceeds customer demands, the district may sell water to out-of-district purchasers.

Actions, Procedures, Performance, and Goals:

The goal of the HCCRD No. 1 is to conserve the waters of the Rio Grande to the maximum extent possible. As such the district seeks the cooperation of all users. The district also holds regular public meetings. The public may have direct input during the meetings or through private contact with a district board member.

Currently, the district has an annual evaluation of the conservation program, and may make revisions to the program. If changes have been made to the plan, an annual report will be generated.

Between 1991 and 1995, the HCCRD No.1 in cooperation with the TWDB, Natural Resource Conservation Service, and the Texas Agricultural Extension Service provided water conservation brochures, conducted irrigation management workshops and field days, implemented a water metering program, and studied canal water losses.

Drought Contingency:

The HCCRD No.1 bases drought contingency planning on evaluation of the water supply projected and received by the EPCWID No.1, since all waters received by HCCRD No.1 are recyclable water from 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 No.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.

CHAPTER 7

PLAN CONSISTENCY

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7.1 INTRODUCTION

The long-term protection of the Region's water resources, agricultural resources, and natural resources is an important component of this 2011 update to the *Far West Texas Water Plan*. Specific guidance was provided to insure that the plan reaches this goal. 31 TAC 357.14 (C) defines this requirement by the following consistency rules:

a) 31 TAC §358.3 relating to guidelines for state water planning,

b) 31 TAC §357.5 relating to guidelines for the development of Regional Water Plans,

c) 31 TAC §357.7 relating to Regional Water Plan development,

d) 31 TAC §357.8 relating to ecologically unique river and stream segments, and

e) 31 TAC §357.9 relating to unique sites for reservoir construction.

Chapter 7 identifies those considerations that provide for 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.

7.2 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 in the tributaries and main branch of the Pecos River. The numerous springs, which represent a transition point between groundwater and surface water, are also recognized in this Plan 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 were based on acceptable levels of water-level decline or historical maximum pumping estimates. Where available, groundwater availability models (GAMs) were used as a tool to view various withdrawal rates in terms of water-level impacts. 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 4 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 4-2 in Chapter 4 provides an overview of these impact evaluations.

Chapters 6 and 8 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.

7.3 PROTECTION OF AGRICULTURAL RESOURCES

Agriculture in Far West Texas, as described in Chapter 1 – Section 1.3.7, 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 4A) reports that in 2006 total sales from irrigation activities produced about $141M and generated about $88M in regional income. The livestock industry produced $197M in total sales and generated an estimated $47M in income. Water is an absolute necessity to maintaining this 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 4 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 4 include an analysis of potential impact to agricultural interests.

An interim project was performed to evaluate the effectiveness of previously recommended practices. A summary of this report titled " Evaluation of Irrigation Efficiency Strategies for Far West Texas: Feasibility, Water Savings and Cost Considerations" is provided in Appendix 1A of Chapter 1.

7.4 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 1.3.8 as including terrestrial and aquatic habitats that support a diverse environmental community as well as provide recreational and economic opportunities. Rare, endangered, and threatened species found in the region are listed in Appendix 1E of Chapter 1. Environmental and recreational water needs are discussed in Chapter 2 – Section 2.5. In Chapter 8, Appendices 8B through 8I describe recommended ecologically unique river and stream segments, while Appendix 8I 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 7.2 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 4-4 in Chapter 4 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 recommends as "Ecologically Unique River and Stream Segments" (Chapter 8 – Section 8.4) 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. A quantitative analysis conducted to assess potential impacts of the Plan on these segments found that all recommended strategies listed in Chapter 4 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.

CHAPTER 8

RECOMMENDATIONS

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8.1 INTRODUCTION

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.

8.2 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. During this planning cycle in particular, the Planning Group had virtually nothing of substance to do until the last six months, during which we have had to meet monthly in order to comply with mandated TWDB deadlines. Some members of the Planning Group feel that they have become irrelevant to the planning process and that, to be blunt, they are wasting their time. 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. <u>Needed Funding for Data Collection in Rural Areas</u>. 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. <u>Open Records Exception for Private Water Data.</u> 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, 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 2011 will be the third 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. In the current water planning cycle, the Initially Prepared Plan is due one day after the regular session closes. This makes informed and current water planning extremely difficult, as numerous water bills (e.g. SB 3) are pending that could impact regional water planning and that likely will not be resolved until the 11th 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.

   Additionally, many voting and non-voting members of the FWTWPG are involved with the legislative session. Every interest represented on the FWTWPG is affected by the session, and many voting and non-voting members (especially our legislative representatives) spend all or much of the session in Austin. As a result, several of our members have difficulty even attending meetings during the session due to their legislative commitments on water and other issues. If the State wants the best regional water plan possible, then structuring the bulk of regional water planning (the final 3-6 months per planning cycle) around legislative sessions will allow greater participation of our voting and non-voting members and also ensure that the current state of water law is known and can be applied effectively by the FWTWPG.

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 will be required in the regional water planning process of assessing water supply availability during the next regional planning period (2011-2016). By rescheduling the due dates in the GMA process, MAG data can be better integrated into the overall state water planning program. The following table provides a suggested timeline for coordinating the interrelated water planning functions.

Proposed Planning Schedule

Planning Process	Current Due Dates	Next Planning Cycle Due Dates	**Proposed Due Dates**
GMAs set DFC	2010	2015	**2013**
TWDB establishes MAG	2011	2016	**2014**
GCD Management Plans	Various*	2017	**2015**
Regional Water Plans	2011	2016	**2016**
State Water Plans	2012	2017	**2017**

* Currently local plans are submitted on staggered 5-year intervals; because the MAGs will be issued in 2011 most GCDs will be resubmitting their plans in 2012.

11. Colonias. The 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 1.7 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 RGSMC is composed of the Rio Grande Compact Commissioners from Colorado, New Mexico and Texas, state water management agencies, local water utilities, and irrigation districts, and university research organizations charged with task of developing a better understanding of salinity sources and concentrations and impacts in the Rio Grande Basin from San Acacia, New Mexico to Fort Quitman, Texas. 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.

8.3 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.

The FWTWPG chooses to respect the privacy of private lands and therefore continues to support the 2006 "Ecologically Unique River and Stream Segments" recommendations (Figure 8-1) 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. 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.

New to the 2011 Plan is an additional recommendation that the Alamito Creek segment above the Big Bend Ranch State Park that is owned by the Trans Texas Water Trust be considered for "Ecologically Unique River and Stream Segment" status (see Section 8.3.7).

A quantitative assessment of how recommended water management strategies (Chapter 4) potentially could affect flows deemed important by the FWTWPG to the Ecologically Unique River and Stream Segments (EURSS) 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

<u>Rio Grande Wild and Scenic River (Big Bend)</u> 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.

<u>McKittrick Canyon and Chosa Creek (Guadalupe Mountains National Park)</u> 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-7) 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-6) 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.

<u>Cienega Creek (Chinati Mountains State Natural Area)</u> is spring fed from high elevation exposures of the Davis Mountains Igneous Aquifer. No strategies use this aquifer as their source supply.

<u>Alamito and Cienega Creeks (Big Bend Ranch State Park)</u> are spring fed from high elevation exposures of the Davis Mountains Igneous Aquifer. No strategies use this aquifer as their source supply.

<u>Alamito Creek (Trans Pecos Water Trust)</u> is spring fed from high elevation exposures of the Davis Mountains Igneous Aquifer. No strategies use this aquifer as their source supply.

<u>Independence Creek (Texas Nature Conservancy – Independence Creek Preserve)</u> is spring fed from the Edwards-Trinity (Plateau) Aquifer. No strategies use this aquifer as their source supply.

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. No strategies use this aquifer as their source supply.

8.3.1 Rio Grande Wild and Scenic River (Big Bend National Park)

The Rio Grande/Rio Bravo in Far West Texas is truly a national treasure with unique ecological and economic features. In 1978, Congress designated a 196-mile segment of the Rio Grande a National Wild and Scenic River. The designated Wild and Scenic stretch of the Rio Grande begins in Big Bend National Park, opposite the boundary between the Mexican states of Chihuahua and Coahuila. It then flows through Mariscal and Boquillas Canyons in the national park. Downstream from the park, it extends along the state-managed Black Gap Wildlife Management Area and several parcels of private land in the Lower Canyons. The wild and scenic river segment ends at the county line between Terrell and Val Verde Counties.

The Rio Grande Wild and Scenic River is significant as part of a valuable and largely intact ecological system representing major riparian and aquatic habitat associated with the Chihuahuan Desert. Spectacular river canyons, the primitive character of the River, and its international flavor combine to form a stimulating environment for high quality scenic and recreational experience.

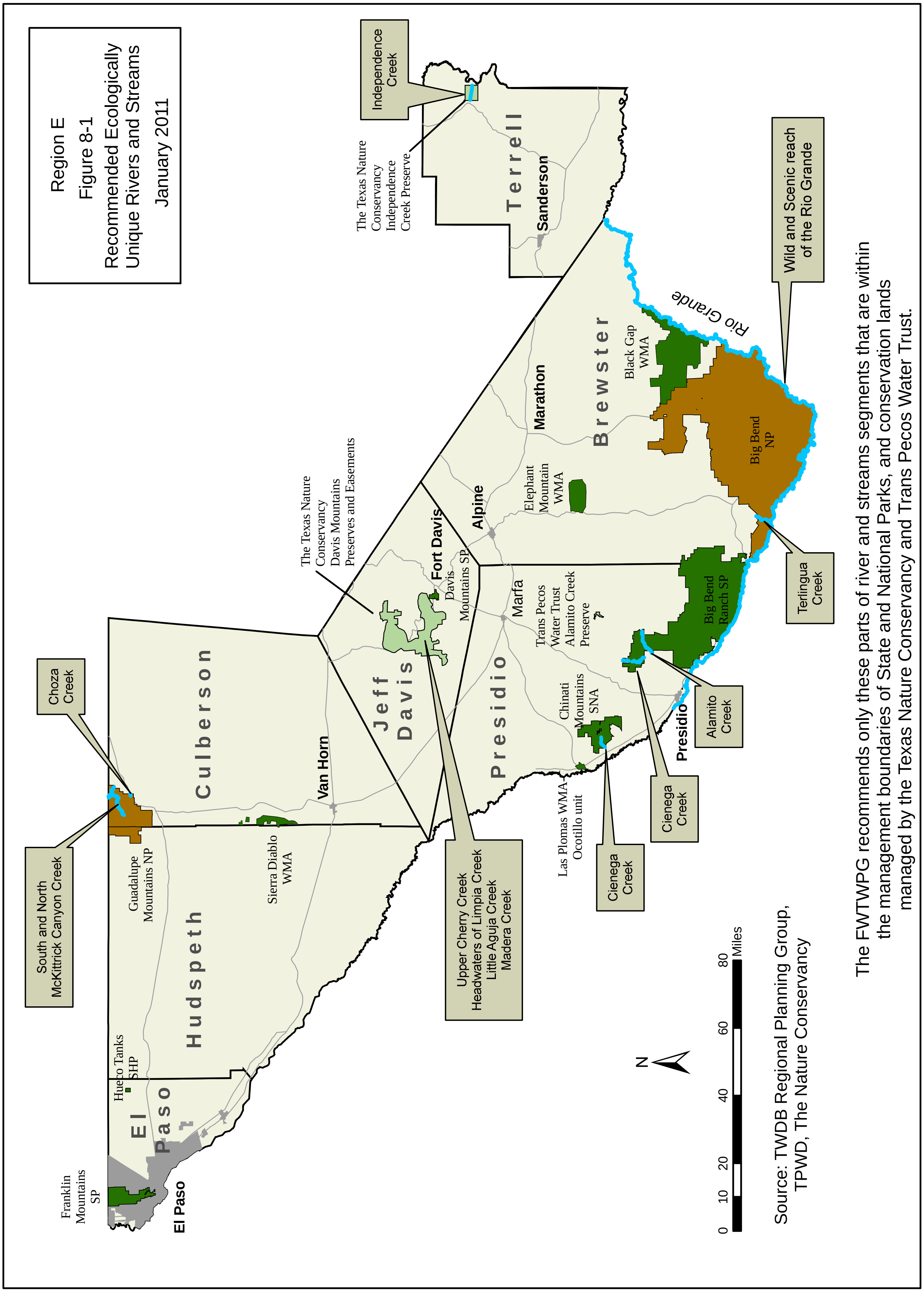

FIGURE 8-1. RECOMMENDED ECOLOGICALLY UNIQUE RIVER AND STREAM SEGMENTS

LBG-GUYTON ASSOCIATES

The FWTWPG recognizes the significance of the 196-mile Rio Grande Wild and Scenic River segment and encourages the proper conservative management of this region. The upper 69-mile section of this corridor lies within the Big Bend National Park, however the National Park Service administers the entire 196-mile designated section. The FWTWPG continues to support the recommendation made in the *2006 Far West Texas Water Plan* that the part of the federally designated Rio Grande that is bordered by the Big Bend National Park and the Black Gap Wildlife Management Area be considered under the guidelines of "Ecologically Unique River and Stream Segments". A detailed information packet pertaining to this river segment is contained in Appendix 8A.

8.3.2 McKittrick Canyon and Choza Creek (Guadalupe Mountains National Park)

McKittrick Canyon and Choza Creek in the Guadalupe Mountains National Park are crucial for maintenance of ecological stability and wildlife health within this higher-elevation Chihuahuan Desert environment. Loss or failure of either of these waterways would cause significant environmental stress. Springs that create the flow in these streams are also historic areas used by pioneers, early ranchers, and settlers. Remains of their homesteads and structures used to manage spring outflow and direct water usage are still visible in and near the springs. The National Park Service is directed to preserve these historic elements and cultural landscapes against unnatural impacts from continued human use, as well as to protect the spring's water quality and quantity from human induced impairment. Those portions of McKittrick Canyon Creek and Choza Creek that flow within the Park boundary continue to be recommended as "Ecologically Unique River and Stream Segments", and are further described in Appendix 8B.

8.3.3 Cienega Creek (Chinati Mountains State Natural Area)

Cienega Creek flows downstream from the spring-fed spring, La Baviza, in the 38,187-acre Chinati Mountains State Natural Area in west-central Presidio County. The spring (cienega) forms a fresh to slightly saline marsh with waters that are slightly geothermal. The habitat supports a fairly intact, diverse marsh with saline grasses, rushes, sedges, and perennials. La Baviza Spring is also identified as a “Major Spring” in Chapter 1 of this Plan. A high diversity of desert bats use the area for feeding and watering. The adjacent Cienega Creek has very good examples of saline marsh and cottonwood gallery woodlands. It is an important wildlife area and is located in the low Chihuahuan Desert where intact wetlands and riparian habitat are quite rare. The portion of Cienega Creek that flows within the State Natural Area boundary continues to be recommended as "Ecologically Unique River and Stream Segments". Maps and photos were not available as of the deadline for this planning period. Further detail is available from the TPWD.

8.3.4 Alamito and Cienega Creeks (Big Bend Ranch State Park)

The entire length of Alamito Creek extends from its confluence with the Rio Grande upstream to north of Marfa in Presidio County. Cienega Creek extends from its confluence with Alamito Creek upstream to its headwaters also in Presidio County. Springs north of the Big Bend Ranch Park form the headwaters of both creeks. The FWTWPG continues to recommend only those stretches of these streams that lie within the boundaries of Big Bend Ranch State Park (Figure 8-1) be considered as “Ecologically Unique River and Stream Segments”. Sections of these creeks within the state park boundary but traversing privately owned internal parcels of land are excluded from this recommendation.

Alamito Creek is recognized as a high quality ecoregional stream with exceptional aquatic life and high aesthetic value. The stream contains a diverse benthic community of macroinvertebrates and fishes (Bayer et al., 1992; Linam et al., 1999). Unique communities of threatened or endangered species include: Concho pupfish (Fed. SOS/St. T), Chihuahua shiner (Fed. SOC/St. T), Mexican stoneroller (Fed. SOC/St. T) (Bayer et al., 1992). Cienega

Creek is an intact desert spring ecosystem displaying overall habitat value. Unique communities of threatened or endangered species include: Big Bend mud turtle and various endangered desert fishes.

8.3.5 Independence Creek (Texas Nature Conservancy – Independence Creek Preserve)

Independence Creek is a large spring-fed creek in northeastern Terrell County. It is the most important and one of the few remaining freshwater tributaries of the lower Pecos River. The Texas Nature Conservancy owns and manages the 19,740-acre Independence Creek Preserve. Caroline Spring, located at the Texas Nature Conservancy’s Preserve headquarters, produces 3,000 to 5,000 gallons per minute and comprises about 25 percent of the Creek’s flow. Independence Creek’s contribution increases the Pecos River water volume by 42 percent and reduces the total dissolved solids, thus improving water quantity and quality. The Preserve hosts a variety of bird and fish species, some of which are extremely rare. Caroline Spring, along with the entirety of the Independence Creek Preserve, is a significant piece of West Texas natural heritage. That portion of Independence Creek that flows through the Preserve continues to be recommended as an "Ecologically Unique River and Stream Segment". Caroline Spring is recognized as a "Major Spring" in Chapter 1. Additional information pertaining to Independence Creek is provided in Appendix 8C.

8.3.6 Madera Creek, Canyon Headwaters of Limpia Creek, Little Aguja Creek, and Upper Cherry Creek (Texas Nature Conservancy – Davis Mountains Preserve)

The wild and remote Davis Mountains is considered one of the most scenic and biologically diverse areas in Texas. Rising above the Chihuahuan desert, the range forms a unique “sky island” surrounded by the lowland desert. Animals and plants living above 5,000 feet are isolated from other similar mountain ranges by vast distances. The Texas Nature Conservancy has established the 32,000-acre Davis Mountains Preserve (with conservation easements on 65,830 acres of adjoining property) in the heart of this region. Madera Creek, Canyon Headwaters of Limpia Creek, Little Aguja Creek, and Upper Cherry Creek form critical wetland habitat and establish base flow to the downstream creeks. The portion of these streams that flow through the Davis Mountains Preserve continue to be recommended as "Ecologically Unique River and Stream Segments". Additional information pertaining to these streams is provided in Appendix 8D.

8.3.7 Alamito Creek (Trans Pecos Water Trust)

The Dixon Water Foundation recently donated a tract of land approximately 35-40 miles south of Marfa in Presidio County to the Trans Pecos Water Trust (TPWT), a not-for-profit 501.c.3 corporation. The 1,061-acre donated property, designated as the Trans Pecos Water Trust Alamito Creek Preserve, includes a 3.5-mile riparian zone of Alamito Creek and a shorter segment of Matonoso Creek. The southern downstream boundary of this property is located where TX 169, also known as Casa Piedra Road, bridges Alamito Creek. The 3.5-mile segment of Alamito Creek within the Preserve boundary is recommended by the FWTWPG as an " Ecologically Unique River and Stream Segment". Appendix 8E contains a map and photographs of the Preserve.

The 2006 Far West Texas Water Plan previously included a downstream stretch of Alamito Creek that flows within the boundary of the Big Bend Ranch State Park (see Section 8.3.4 above). The portion of Alamito Creek that separates the TPWT Preserve segment from the Big Bend Ranch State Park segment is privately owned and is not a part of this recommendation.

Alamito Creek runs on the surface for most of the TPWT Preserve stretch. There are pools with year round populations of endemic fish, amphibians and aquatic invertebrates. Alamito Creek supports an extensive cottonwood *bosque*. Ash and willow species are present. There is very little tamarix/salt cedar. The segment offers superb wildlife habitat, natural diversity, and perennial stream flow, deserving recognition as an ecologically unique stream segment.

The Dixon Water Foundation property of approximately 8,000 acres was formerly the Kennedy Ranch. The TPWT parcel is being donated with restrictions to be managed in perpetuity as a preserve. The rest of the former ranch will be offered for sale in 300-800 acre parcels with stringent conservation easements to be donated to and managed by the TPWT.

8.4 TPWD Recommended Ecologically Significant River and Stream Segments

At the completion of the first round of regional water planning, the Texas Parks and Wildlife Department (TPWD) was asked to play a more active role in assisting the regional planning groups with environmental water needs assessment. In response, TPWD provided each of the 16 regional planning groups with their recommendation of "Ecologically Significant River and Stream Segments" along with supporting data for each segment. The FWTWPG greatly appreciates the efforts provided by the agency and used the information in formulating their recommendations pertaining to "Major Springs" (Chapter 1) and "Ecologically Unique River and Stream Segments" (this chapter).

The FWTWPG approved the inclusion in the Plan of three suggested stream segments that lie within the boundaries of state-managed properties. These stream segments include Cienega Creek in the Chinati Mountains State Natural Area and Alamito and Cienega Creeks in the Big Bend Ranch State Park. The entire TPWD recommendation document can be viewed in Appendix 8F.

8.5 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 *2011 Far West Texas Water Plan* does not recommend any watercourse for designation as "Unique Sites for Reservoir Construction."

APPENDIX 8A

RIO GRANDE

WILD AND SCENIC RIVER

APPENDIX 8A
RIO GRANDE WILD AND SCENIC RIVER

The Rio Grande/Rio Bravo in Far West Texas is truly a national treasure with unique ecological and economic features. The Far West Texas Regional Water Planning Group recognizes the significance of the 196-mile Rio Grande Wild and Scenic River segment and encourages the proper conservative management of this region. The upper 69-mile section of this corridor lies within the Big Bend National Park, however the National Park Service administers the entire 196-mile designated section. For purposes of the Far West Texas Regional Water Plan, the Planning Group officially recommends that only the part of the federally designated Rio Grande that is bordered by the Big Bend National Park be considered under the guidelines of "Ecologically Unique River and Stream Segments". The following river segment characterization is principally contained with the National Parks Service / Rio Grande Wild and Scenic River Final General Management Plan and Environmental Impact Statement (http://www.nps.gov/rigr/pphtml/documents.html) and the Big Bend National Park / Rio Grande Wild and Scenic River web site (http://www.nps.gov/bibe/rgwsr.htm).

In 1978, Congress designated a 196-mile segment of the Rio Grande a National Wild and Scenic River (Figure 8.1). The Wild and Scenic River Act of 1968 directs that the designated rivers "… be preserved in free-flowing condition, and that they and their immediate environments be protected for the benefit and enjoyment of the present and future generations." Only 2% of America's rivers are "free flowing" and qualify for this designation. The Rio Grande Wild and Scenic River was designated for the following purposes:

- *To preserve the free-flowing condition and essentially primitive character of the river (except as provided by treaty)*
- *To protect the outstanding scenic, geologic, fish and wildlife, recreational, scientific, and other similar values of the river and its immediate environment*
- *To provide opportunities for river-oriented recreation that is dependent upon the free-flowing condition of the river and consistent with the primitive character of the surroundings.*

The Rio Grande Wild and Scenic River is significant as part of a valuable and largely intact ecological system representing major riparian and aquatic habitat associated with the Chihuahuan Desert. Spectacular river canyons, the primitive character of the river, and its international flavor combine to form a stimulating environment for high quality scenic and recreational experience. Protecting and managing this outstanding natural resource extends a valuable opportunity for international cooperation between the United States and Mexico.

Location

Under the Wild and Scenic River Act (16 USC 28 §1274), the following segment is designated:

The segment on the United States side of the river from river mile 842.3 above Mariscal Canyon downstream to river mile 641.1 at the Terrell-Val Verde County line,…

The International Boundary and Water Commission later revised the beginning and ending river miles to 853.2 and 657.5 respectively. The southern side of the river is not designated because it is owned by Mexico.

The designated Wild and Scenic stretch of the Rio Grande begins in Big Bend National Park, opposite the boundary between the Mexican states of Chihuahua and Coahuila. It then flows through Mariscal and Boquillas Canyons in the national park. Downstream from the park, it extends along the state-managed Black Gap Wildlife

Management Area and several parcels of private land in the Lower Canyons. The wild and scenic river segment ends at the county line between Terrell and Val Verde Counties. There are plans to introduce legislation that will extend the Wild and Scenic designation to the western National Parks boundary, extending the total distance by approximately 65 miles.

The National Park Service's jurisdiction on the Rio Grande Wild and Scenic River downstream from the park boundary includes only the river area from the United States/Mexico international boundary in the middle of the deepest channel to the gradient boundary at the edge of the river on the United States side. The gradient boundary, as recognized by the State of Texas, is defined as located midway between the lower level of the flowing water that just reaches the cut bank and the higher level of it that just does not overtop the cut bank. The riverbed of the Wild and Scenic River downstream from the park is the property of the State of Texas.

The stretch of river is classified as either wild or scenic. Wild sections are defines as "…those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watershed or shorelines essentially primitive and water unpolluted…these represent vestiges of primitive America…" Scenic sections pertain to "…those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds largely primitive and shorelines largely undeveloped, but accessible in places by roads…"

The following sections are classified as wild: Talley to Solis, which includes Mariscal Canyon; the entrance to Boquillas Canyon to the exit of Boquillas Canyon; and Reagan Canyon to San Francisco Canyon (the bulk of the "Lower Canyons"). The remainder of the Wild and Scenic River is classified as scenic.

Natural Resources

Scenic Value

The area encompassing the designated Rio Grade Wild and Scenic River contains views of the river and surrounding canyons with outstanding visual quality. Rugged, steep-walled canyons, scenic rapids, and unspoiled views contribute to the river and its surroundings, are important values for river visitors.

Geologic Features

Rock layers exposed by the Rio Grande were deposited about 100 million years ago. Subsequent uplifting, folding, faulting, and cutting of the river have produced the present topography. Near its upstream end, the Rio Grande has sliced through the surrounding rocks to form steep-walled, sometimes narrow canyons. Downstream from Boquillas Canyon, the river flows across a relatively broad and open floodplain, or *vega*. Near Reagan Canyon, the floodplain narrows abruptly, and the river flows in a continuous deeply cut canyon for almost 40 miles. In the Lower Canyons portion of this segment, the river and its tributaries lie 500 to 1,500 feet below the surrounding plateaus.

Fish and Wildlife

The area is an outstanding example of Chihuahuan Desert wildlife in Texas. This isolated area represents a rapidly dwindling, irreplaceable natural resource. The riparian corridor, containing more vegetative growth and a reliable water supply, attracts many wildlife species.

Forty-six known species of fish inhabit the Big Bend area; 34 of these are native. Shiners and daces are the most abundant fishes in the Rio Grande. Larger fish found here are the long-nose gar, channel catfish, blue catfish, and European carp. Six native fish species have been extirpated in recent decades because of the effects of dams, habitat modification, and competition from introduced species.

Numerous wildlife species are residents of the river corridor, and many others, especially birds, use the Rio Grande as a travel corridor. Mammals include skunks, rodents, squirrels, rabbits, raccoons, and ringtails. Mountain lions (locally called panthers) occupy the area, and black bears and desert bighorn sheep occasionally can be seen.

Birds are the most frequently seen animals along the river. Common resident species seen or heard along the river include yellow-breasted chat, black phoebe, white-winged dove, canyon wren, and roadrunner. Ravens, turkey vultures, and various raptors regularly soar overhead. Peregrine falcons (*Falco peregrinus*) use high cliff faces for nesting in Santa Elena, Mariscal, and Boquillas canyons. Reptiles include lizards, snakes, and both terrestrial and aquatic turtles. Several amphibian species also are present.

Native freshwater mussels have virtually disappeared from this area. Some historic species no longer can be found, and the more persistent Texas hornshell and Salina Mucket have not been found alive in recent years. Other aquatic species may be in danger of extirpation. Reductions in water quality and quantity adversely affect these and other aquatic species.

Many exotic or nonnative species are found in the Rio Grande. Twelve nonnative fish species compete with the remaining native species. Nutria, a large nonnative rodent, is no common, and the exotic Asian clam is abundant. At present there is insufficient information about the distribution and spread of exotic species.

Special Status Species

The following federally listed species may be found in the river corridor.

Fishes. The endangered ***Big Bend gambusia*** *(Gambusia gaigeii)* is known only from spring habitats near Boquillas Crossing and Rio Grande Village in Big Bend National Park, within the management area of the river. The population of this fish species at Boquillas Spring died when the spring stopped flowing in 1954. The population near Rio Grande Village drastically declined between 1954 and 1956, after the spring flow was altered to provide a fishing pool. By 1960, the Big Bend gambusia no longer could be found at the Rio

Grande Village location. The loss of this population probably was due to competition with the western mosquitofish and predation by the introduced green sunfish. All the present populations of the Big Bend gambusia are descendants of two males and one female taken from the declining Rio Grande Village population in 1956. The only known wild population exists in a protected pond in Big Bend national Park (Texas Parks and Wildlife Department Web site). A recovery plan is in effect for this species that calls for its reintroduction (USFWS 1984).

Other fish species of concern are as follows: Chihuahua shiners are know in the United States only in the park, where they inhabit the lower reaches of Tornillo and Terlingua Creeks. The Mexican stoneroller fish, the blue sucker, and the Conchos pupfish also are found in the area.

Black-Capped Vireos. Endangered ***black-capped vireos*** *(Vireo atricapillus)* nest in Texas during April through July and spend the winter on the western coast of Mexico. Their habitat is primarily rangelands with scattered clumps of shrubs separated by open grassland. They nest in shrubs such as hennery oak or sumac. They may occasionally use the river corridor. This species' listing as endangered is due to the dwindling population numbers from nesting habitat loss and cowbird parasitism.

Cactus Species. The threatened **bunched cory cactus** *(Coryphantha ramillosa)* is found on slopes and ledges of sparsely vegetated limestone rock outcrops (most commonly of the Boquillas or Santa Elena Formations) in the lechuguilla shrublands in Big Bend national Park and on large private ranches. This species is known from about 25 sites in southern Brewster County, many in Big Bend National Park. It also can be found in northern Coahuila, Mexico.

The ***Chisos Mountains hedgehog cactus*** *(Echinocereus chisoenis* var. *chisoenis),* also a threatened species, is known to occur in the river corridor. These cacti are found in low elevation desert grasslands or sparsely vegetated shrublands on gravelly flats and terraces in the Chihuahuan Desert. This species is known from about a dozen sites, all in Big Bend national Park. No federally designated critical habitat for this species exists in Terrell or Brewster County.

Vegetation

The Chihuahuan Desert, through which the Rio Grande Wild and Scenic River flows, exhibits a great diversity of vegetation types, which have been categorized according to topography. The vegetation adjacent to the river is adapted to flooding and wet soils. Willows, canes, reeds, seepwillows, acacias, and grasses are the major components of this association. Upslope, the vegetation becomes more desertlike, with lechugilla, blackbrush, catclaw acacia, candelilla, saltbush, mesquite, creosote bush, chino grama, and a variety of cacti predominating. Cracks in the cliff walls harbor a distinctive plan community of candelilla, rock nettle, and poison ivy.

The riparian zone varies from narrow intra-canyon banks to floodplains more than 0.5 mile wide. Early reports indicated that lance-leaf cottonwoods and willows were common, but by the early 1900s most of the trees had been harvested for use in mining operations, and their seedlings rarely survived grazing.

Tamarisk, giant river cane, Bermuda grass, and other invasive plant species have become established along the Rio Grande. In some places these exotic species have forced out native vegetation and form an impassable thicket.

Cultural Resources

The canyons and valleys of the Rio Grande have been a homeland to people for many centuries. The area contains a number of prehistoric and historic cultural resources that supply limited views into the lifestyle of various cultures over the last 10,500 years. Many sites along the wild and scenic river are undisturbed, which enhances their scientific value. Reconnaissance surveys have located a significant number of prehistoric sites on both sides of the river. These sites, which represent occupation and exploration activities by the prehistoric inhabitants, are found in caves, rock shelters, terraces, talus slopes, and canyon rims.

Throughout the prehistoric period, people found shelter and maintained open campsites throughout what is now Big Bend National Park. Archeological records reveal an Archaic-period desert culture whose inhabitants developed a nomadic hunting and gathering lifestyle that remained virtually unchanged for several thousand years. American Indian cultures represented are the Chisos, Mescalero Apache, Kickapoo, and Comanche. Sites containing ceramic artifacts suggest that some later indigenous peoples had a semisedentary lifestyle and practiced limited agriculture along the river.

The historic period began in 1535 with the explorations of Alvar Nuñez Cabeza de Vaca in the Texas Trans-Pecos region. During the late 1700s, Spanish presidios were established along the Rio Grande at San Vicente, Coahuila, and along the San Carlos River at San Carlos, Chihuahua.

Control of the area was passed to the United States after the Mexican-American War (1846-1848). A series of army posts was established along the Rio Grande in an attempt to stop Comanche and Apache raids. The first accurate maps of the Rio Grande canyon areas were completed by Army topographic engineers and the United States-Mexico Boundary Commission in the 1850s. Around that time, a wagon road was established to link San Antonio and El Paso. The road tied the region into the trade network that stretched from California to the Gulf of Mexico.

Grazing history along the Rio Grande dates back to the early Spanish missions established between 1670 and 1690. These missions had become major centers of livestock concentration by 1700.

Hispanic settlements existed near the Rio Grande in 1805. Mexicans farmed and ranched the area throughout the 1800s. Beginning in the 1880s, Anglo-Americans established ranches throughout the area and began farming in the early 20th century. Some farmers and ranchers left the area for a short hiatus during the Mexican Revolution. Cotton and food crops were grown around Castolon and what is now Rio Grande Village even after Big Bend National Park was established in 1944.

Quicksilver (mercury) was discovered in the area in the late 19th century, and later finds of silver and fluorite attracted hundreds of miners and prospectors. A unique facet of the continuing Rio Grande history is the use of the candelilla plant to produce high-quality wax. This wax has been used in the manufacture of candles, waxes, gum, and phonograph records.

Sites of historical interest in the Lower Canyons are an abandoned candelilla operation, the Asa Jones Waterworks, Dryden Crossing, and Burro Bluff, the site of an old trail built by cattlemen for access to the Texas side of the river.

A review of the National Register of Historic Places reveals that four sites that are listed in the national register are in the river corridor in Big Bend National Park: Sublett Farm, Daniels Farm, the Castolon Historic District, and the Hot Springs District

The Texas Historical Commission conducted a reconnaissance survey of the river corridor from La Linda to Dryden Crossing in the 1970s (Mallouf and Tunnel 1977). The researchers recorded 83 prehistoric sites and 5 historic sites on that survey. Some of those are on the Mexican side of the river. The sites represented human occupation and use of the river area throughout the last 12,000 years. The potential for evidence of Paleo-Indian occupation exists in some of the more protected cave and rock shelter sites. Because they are on nonfederal land, no determination has been made about the eligibility of the prehistoric or historic sites in the Lower Canyons for the National Register of Historic Places.

Resource Concerns

Diminishing flows in the Rio Grande is an international, national, and regional concern. This concern is heightened by declining water quality and the presence of invasive species.

The Rio Grande, one of the longest rivers in the United States, is no longer a naturally flowing river along its entire length. Extensive diversion networks and dams control flows on the river to provide water for a variety of human needs. The high flows and periodic floods necessary to maintain the river channels have been reduced by 75% in the Rio Grande below El Paso and by 50% on the Rio Conchos over the years. Reduced flows below Fort Quitman have resulted in a long stretch of the river with no defined channel, and the river in that area has become a tamarisk thicket. The amount of water that reaches Big Bend National Park and the Wild and Scenic River has been reduced by more than half the historic level. Spring inflows and unregulated tributaries increase the average annual streamflow in the reaches of the Wild and Scenic River.

Current water quality in the Rio Grande is mitigated and freshened by groundwater (springs) inflows from the Langford Hot Springs Complex in Big Bend National Park and the Lower Canyon Thermal Springs Complex downstream. *(See additional discussion pertaining to these spring complexes in the "Major Springs" Section of Chapter 1)* The role of these springs in controlling water quality is so important that in discussions with the Texas Commission on Water Quality, it is recognized that water quality in the entire segment would not meet standards for recreational use or fish consumption without groundwater contributions from several spring systems.

The Rio Grande Wild and Scenic River has lost five species of fish and possibly could lose mussel species and a turtle. Inadequate river flows are compromising aquatic and terrestrial species and associated habitats. The Rio Grande corridor serves as important habitat for several state and federally listed threatened and endangered species. The river corridor could provide sufficient habitat to reintroduce or strengthen critical species.

Invasive or introduced species such as tamarisk (salt cedar) and nutria have been observed along the river corridor. There is concern about ways to control these species and the impact they could have on native plants and wildlife.

Cooperative Efforts

Big Bend National Park and the Rio Grande Wild and Scenic River have undertaken several tasks to define, protect, and better manage water resources. In partnership with the Comisión Nacional de Áreas Naturales Protegida, the World Wildlife Fund, the Rio Grande Institute, and Texas Parks and Wildlife, the Park is restoring the mouth of Boquillas Canyon by eradicating invasive species and planting natives. With projects such as this, a valuable opportunity exists for binational cooperation between the United States and Mexico to protect and manage this outstanding primitive resource.

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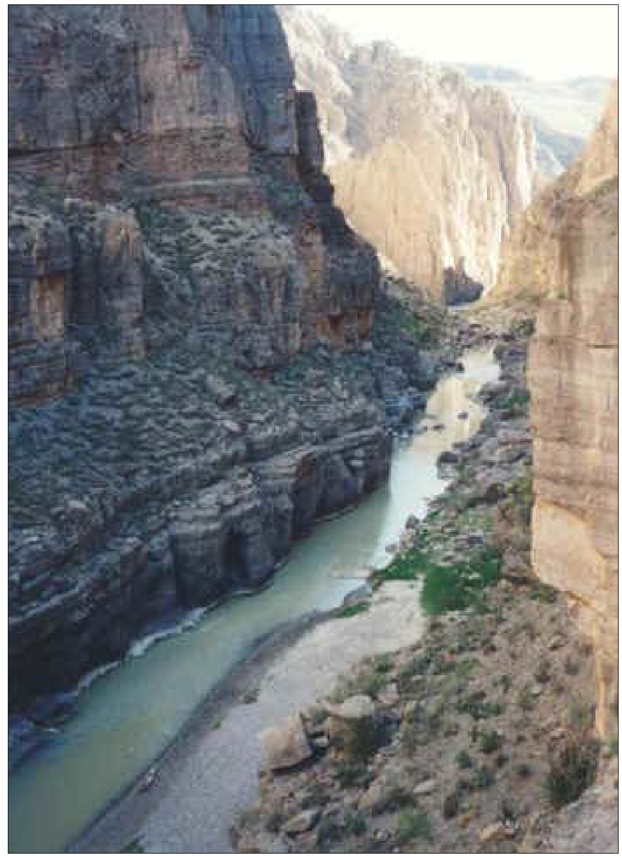
RIO GRANDE WILD AND SCENIC RIVER

NPS Photo



NPS Photo

Rio Grande - Mariscal Canyon
Big Bend National Park

NPS Photo

NPS Photo

Rio Grande - Santa Elena Canyon
Big Bend National Park

RIO GRANDE – WILD AND SCENIC RIVER

APPENDIX 8B

MCKITTRICK CANYON STREAM

CHOZA CREEK

(GUADALUPE MOUNTAINS NATIONAL PARK)

APPENDIX 8B

McKittrick Canyon Stream (Guadalupe Mountains National Park)

McKittrick Canyon stream consists of two headward branches in North and South McKittrick Canyon and a downstream reach formed by coalescing of the two headward branches. Both headward segments are fed by unnamed springs and the South McKittrick branch gains springwater at several points along its course. McKittrick Canyon stream is by far the largest of a very small number of perennially flowing streams in the Guadalupe Mountains in Texas and New Mexico. It supports substantial numbers and species of wildlife, as well as a riparian zone at the bottom of a steep canyon ranging up to 2000 feet deep. During the fall, scenic canyon walls are a backdrop to displays of brilliantly colored Bigtooth maples. The canyon is the only known habitat for an isolated population of a moss, *Venturiella sinensis* var. *angustiannulata*, whose closest relatives occur in China and within a small refugium in Oklahoma. Several areas in the canyon are breeding habitat for the Mexican Spotted Owl (*Strix occidentalis lucida*), officially list as a USF&WS Threatened species. There is one known nesting site for the recently de-listed Peregrine Falcon (*Falco peregrinus*) in the canyon cliffs. The headward branches flow through two areas officially designated as Research Natural Areas. The stream recharges an alluvial aquifer restricted to the canyon bottom, which supplies public drinking water at two park facilities.

North Branch - Guadalupe Peak 7 ½ min. Quadrangle

The flowing portion of the stream heads at a spring only a short distance into New Mexico and crosses into Texas three times. The state lines are also the boundaries between Guadalupe Mountains National Park and the Lincoln National Forest. The westernmost crossing into Texas occurs at:

UTM Coordinate N	3540258	Zone 13, Projection: NAD 1927 Conus
UTM Coordinate E	518792	

Continuing downstream generally southeast to the point where the northern branch joins the southern branch at:

UTM Coordinate N 3538348
UTM Coordinate E 520800

South Branch - Guadalupe Peak 7 ½ min. Quadrangle

The flowing part of the stream heads at a spring near:

UTM Coordinate N 3536021
UTM Coordinate E 518782

and continues to the junction with the north branch noted above.

Main Branch - Guadalupe Peak 7 ½ min. Quadrangle

Beginning at the junction noted above and continuing generally eastward to the point where the streambed exits the park at:

UTM Coordinate N 3537890
UTM Coordinate E 523616

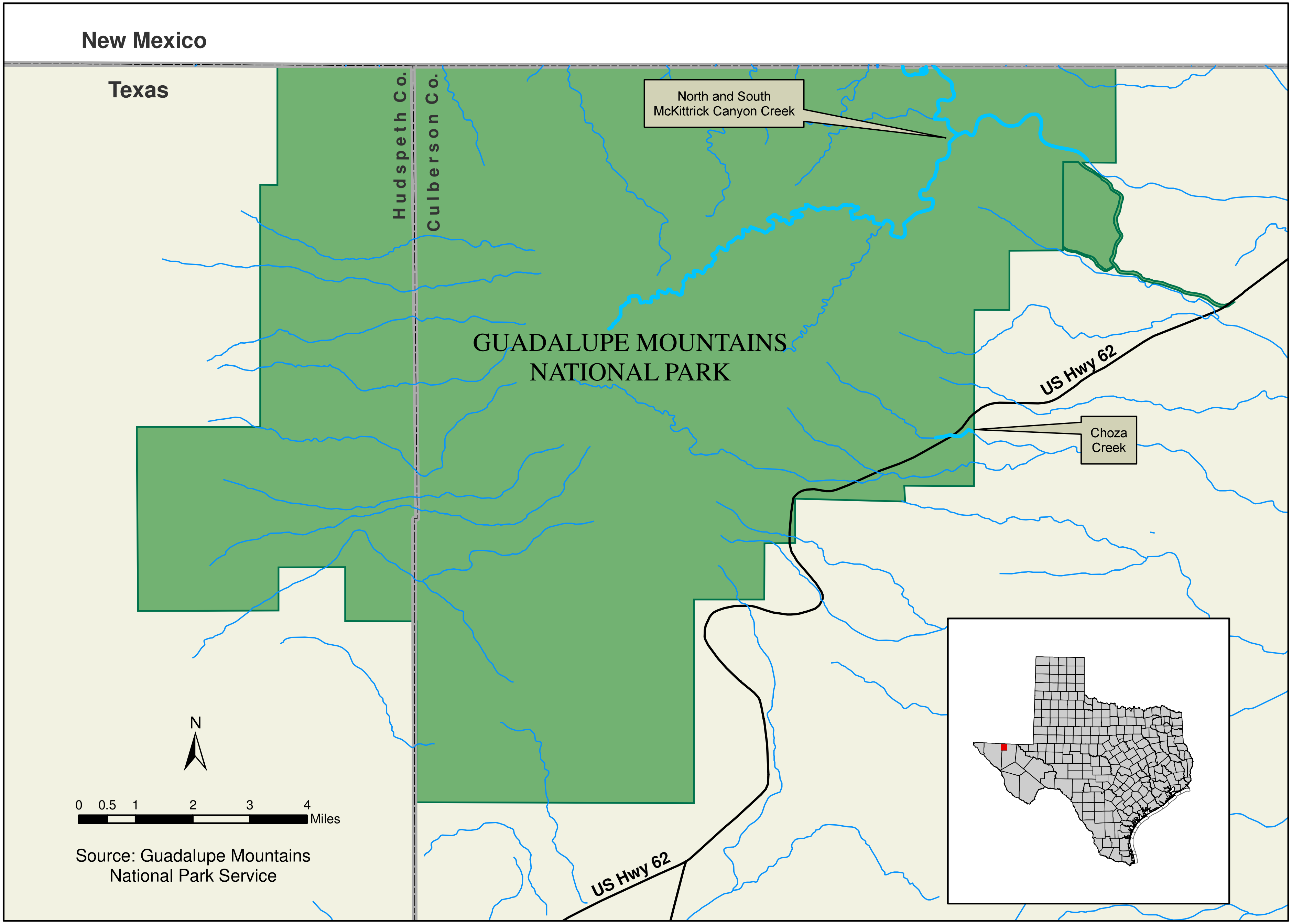
Choza Stream (Guadalupe Mountains National Park)

The Choza Stream heads at Choza Spring and supports a narrow riparian habitat that extends for almost a mile to the southeast. It gains volume at one point immediately north of Highway 62-180 and, in wet years, another diffuse or multiple point area south of that highway. The latter area supports potentially classifiable wetland habitat. The stream provides critical habitat and a vital water source for desert wildlife. The heading spring discharges at:

UTM Coordinate N 3529837 Zone 13, Projection: NAD 1927 Conus
UTM Coordinate E 520309

and the stream exits the park at:

UTM Coordinate N 3529990
UTM Coordinate E 521158



LOCATION OF McKITTRICK CANYON AND CHOZA STREAMS
GUADALUPE MOUNTAINS NATIONAL PARK

LBG-GUYTON ASSOCIATES

McKittrick Canyon – Guadalupe Mountains NPS Photo by George Hosek

McKITTRICK CANYON STREAMS

Choza Stream Source

Chozas Stream Side Inflow

Choza Stream Lower Reach

Photos courtesy of G. Bell, NPS

CHOZA STREAM

LBG-GUYTON ASSOCIATES

APPENDIX 8C

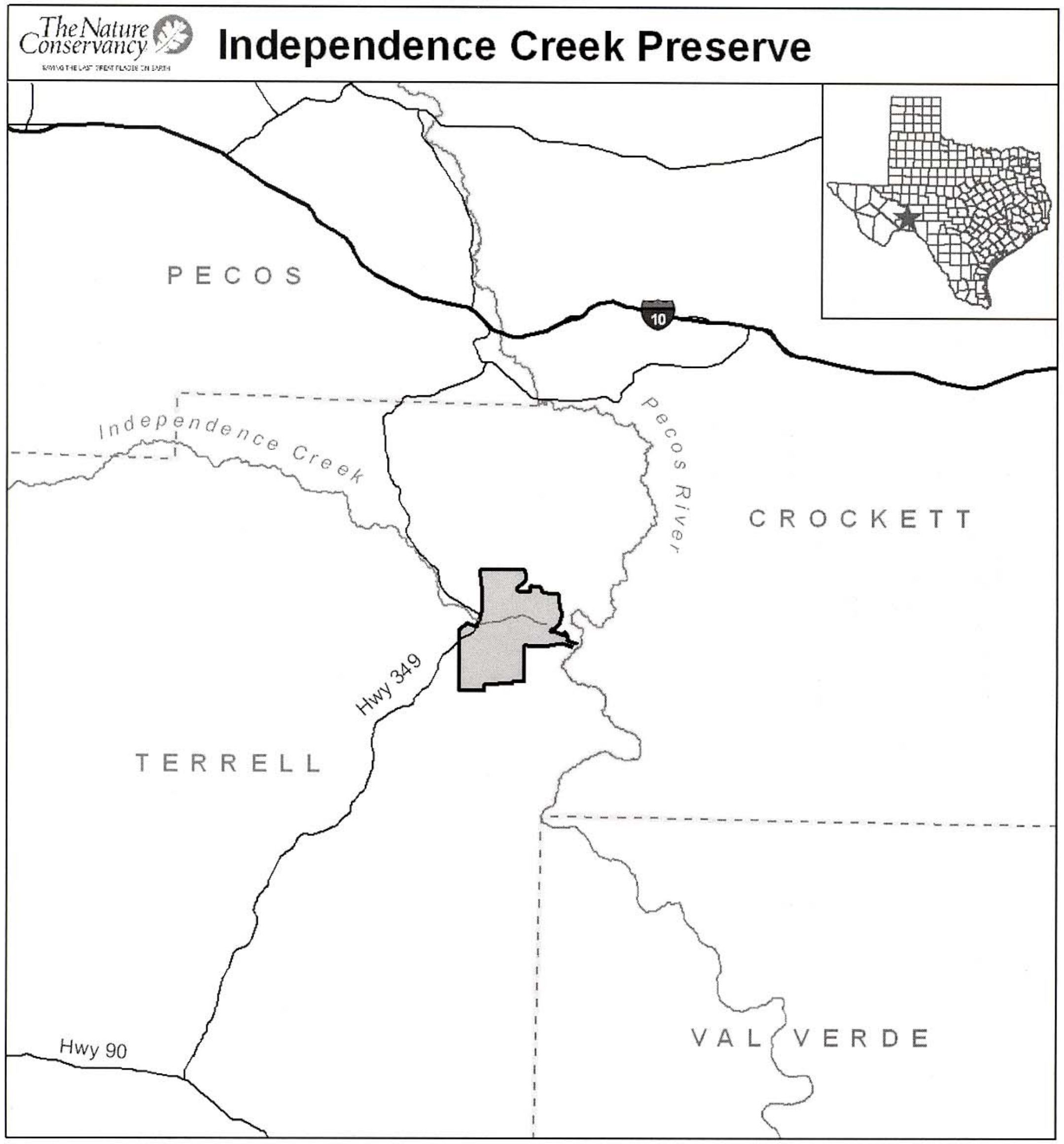
INDEPENDENCE CREEK

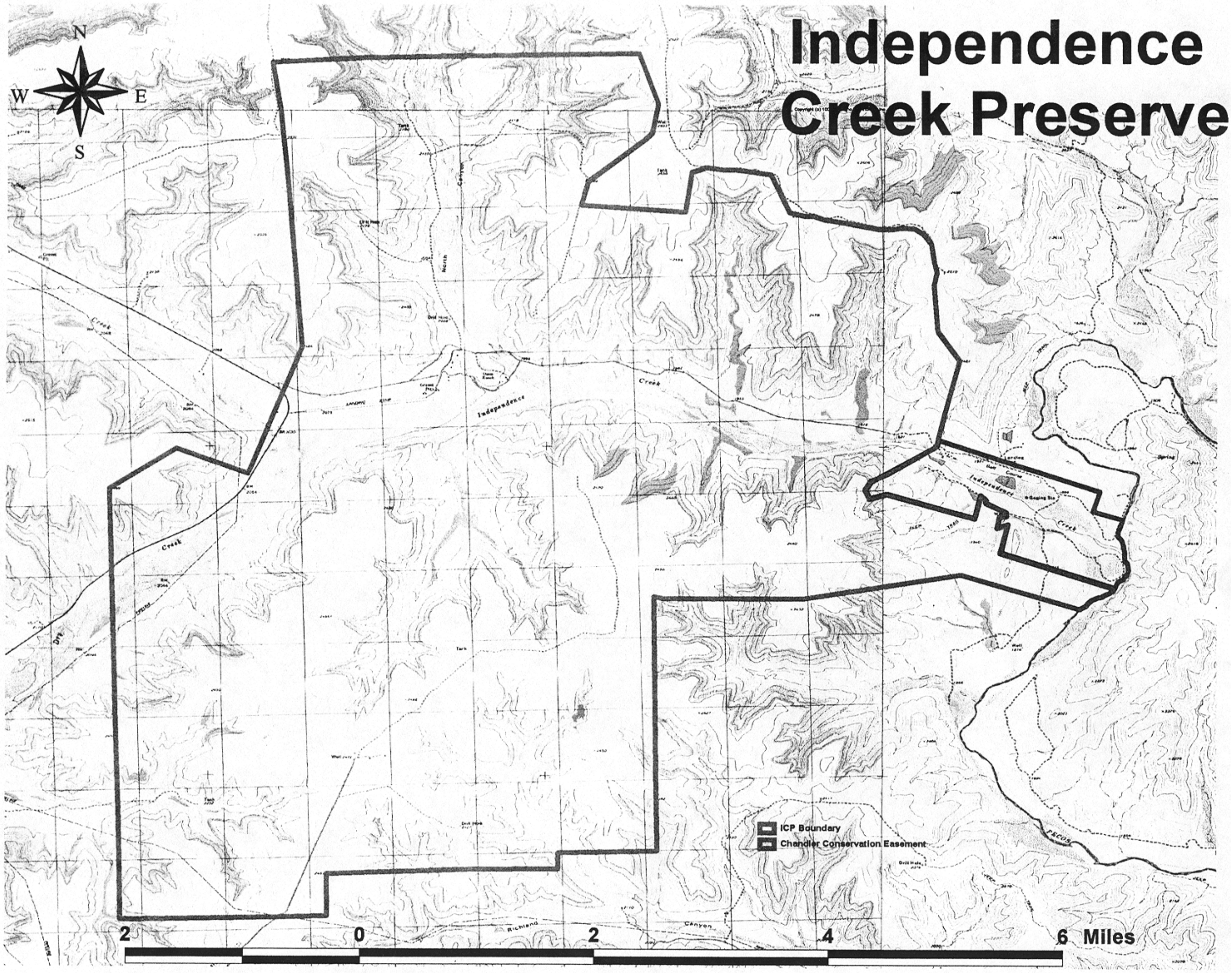
(TEXAS NATURE CONSERVANCY PRESERVE)

APPENDIX 8C

Independence Creek (Texas Nature Conservancy Preserve)

The Texas Nature Conservancy's Independence Creek Preserve is located near the downstream terminus of Independence Creek in northeastern Terrell County. Caroline Spring, located at the Preserve headquarters, produces 3,000 to 5,000 gallons per minute and comprises about 25 percent of the creek's flow. Downstream, Independence Creek's contribution increases the Pecos River water volume by 42 percent and reduces the total dissolved solids by 50 percent, thus improving water quantity and quality. The preserve hosts a variety of bird and fish species, some of which are extremely rare. Caroline Spring, along with the entirety of the Independence Creek Preserve (19,740 acres), is a significant piece of West Texas natural heritage. Caroline Spring is identified as a "Major Spring" in Chapter 1.


The Nature Conservancy
Independence Creek Preserve
PECOS
10
Independence Creek
Pecos River
CROCKETT
Hwy 349
TERRELL
Hwy 90
VAL VERDE



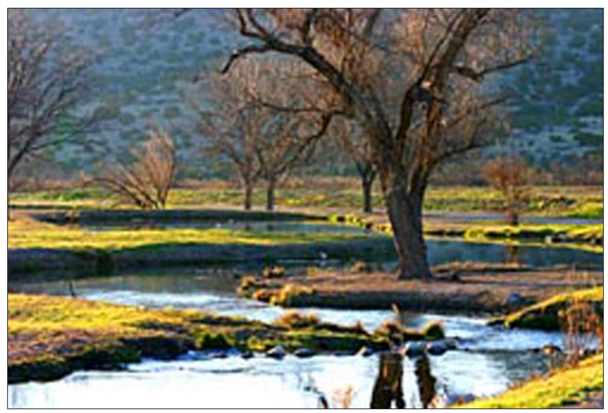
Independence
Creek Preserve
N
S
E
W
ICP Boundary
Chandler Conservation Easement
Independence
Creek
North
2
0
2
4
6 Miles

Independence Creek
Lynn McBride, TNC

Independence Creek
,John Karges, TNC

Independence Creek
Lynn McBride, TNC

Independence Creek Preserve
Lynn McBride, TNC



Independence Creek Preserve
Lynn McBride, TNC

Caroline Springs
Independence Creek
,John Karges, TNC

TNC INDEPENDENCE CREEK PRESERVE STREAMS

LBG-GUYTON ASSOCIATES

APPENDIX 8D

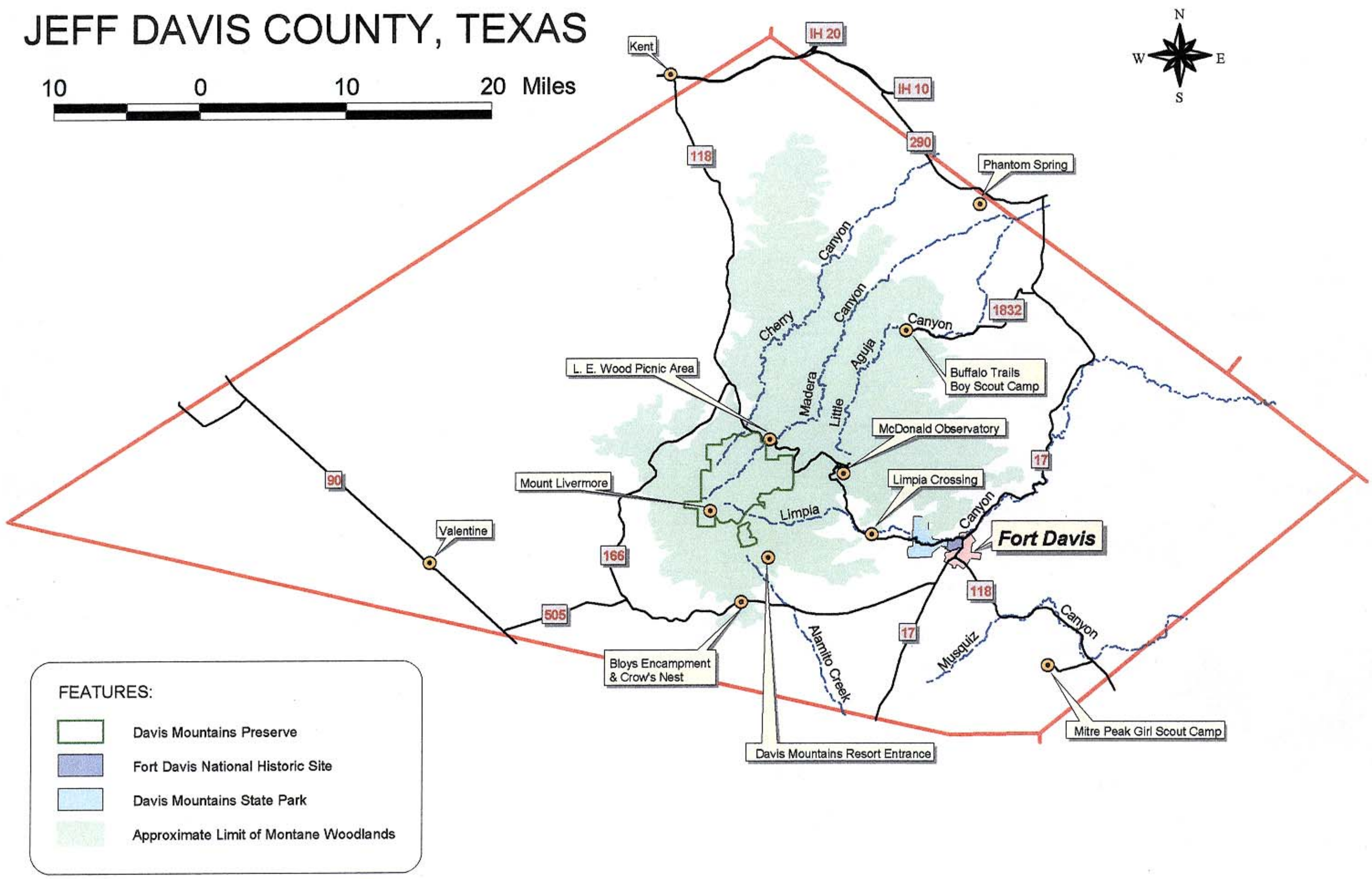
DAVIS MOUNTAINS STREAMS

(TEXAS NATURE CONSERVANCY PRESERVE)

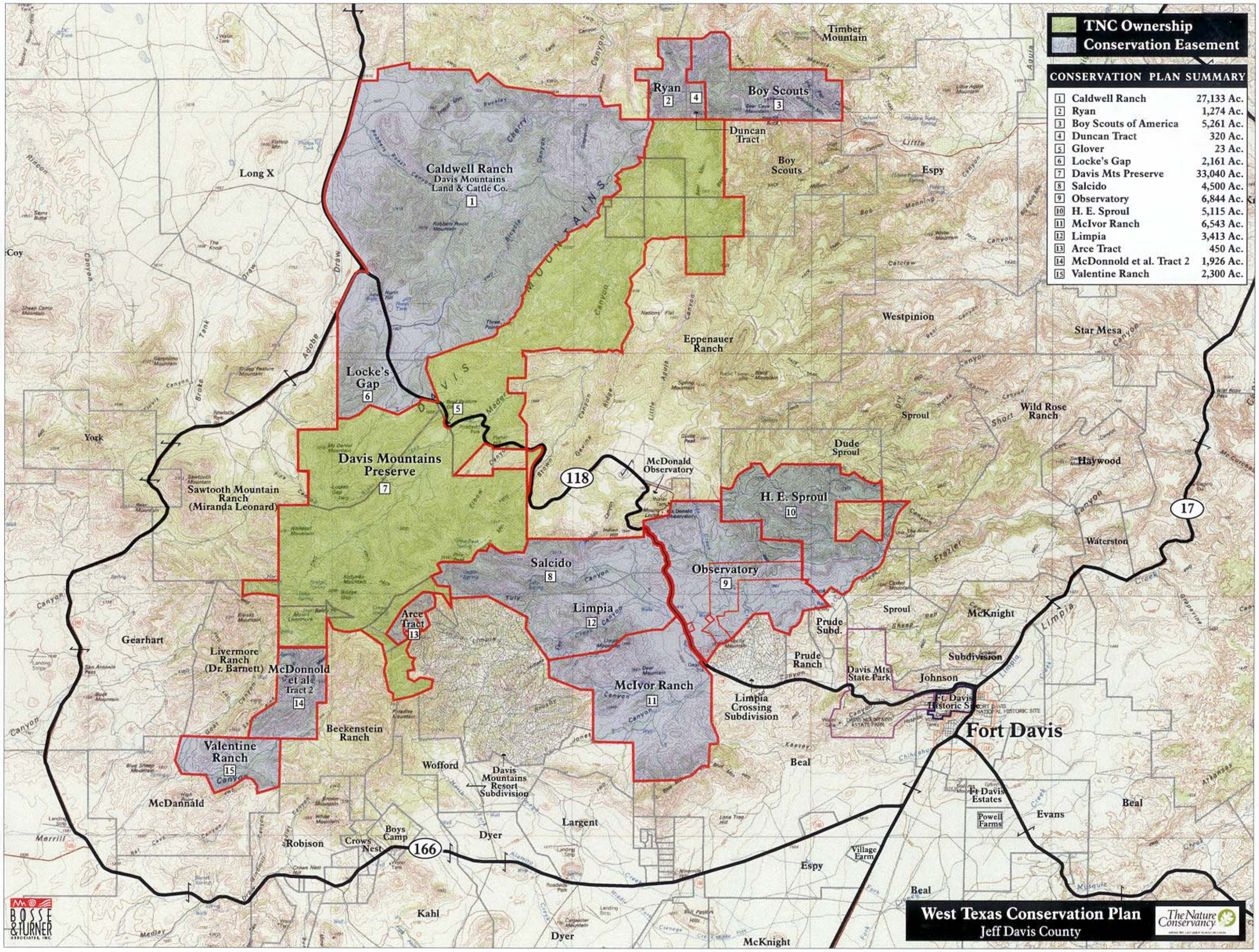
APPENDIX 8D

Davis Mountains Streams (Texas Nature Conservancy Preserve)

The wild and remote Davis Mountains are considered one of the most scenic and biologically diverse areas in Texas. Rising above the Chihuahuan desert, the range forms a unique "sky island" surrounded by the lowland desert. Animals and plants living above 5,000 feet are isolated from other similar mountain ranges by vast distances. The Texas Nature Conservancy has established the 32,000-acre Davis Mountains Preserve (with conservation easements on 65,830 acres of adjoining property) in the heart of this region. The headwaters of Madera, Limpia, Little Aguja and Upper Cherry Creeks originate within the boundaries of the Preserve. Tobe, Bridge, Pine and Limpia Springs (identified as "Major Springs in Chapter 1) contribute to these headwaters and form critical wetland habitat and establish base flow to the downstream creeks.



JEFF DAVIS COUNTY, TEXAS
10
0
10
20 Miles
N
W
E
S
Kent
IH 20
IH 10
290
118
Phantom Spring
1832
Canyon
Cherry
Canyon
Madera
Canyon
Aguja
Little
Buffalo Trails
Boy Scout Camp
L. E. Wood Picnic Area
McDonald Observatory
17
Limpia Crossing
Mount Livermore
Limpia
Canyon
Fort Davis
90
Valentine
166
118
505
17
Musquiz
Canyon
Alamito Creek
Bloys Encampment
& Crow's Nest
Davis Mountains Resort Entrance
Mitre Peak Girl Scout Camp
FEATURES:
Davis Mountains Preserve
Fort Davis National Historic Site
Davis Mountains State Park
Approximate Limit of Montane Woodlands



LBG-GUYTON ASSOCIATES

Little Aguja Creek

Madera Canyon Creek

Madera Canyon Creek

Photos courtesy of John Karges, TNC

TNC DAVIS MOUNTAIN PRESERVE STREAMS

LBG-GUYTON ASSOCIATES

APPENDIX 8E

TRANS PECOS WATER TRUST

ALAMITO CREEK PRESERVE

APPENDIX 8E

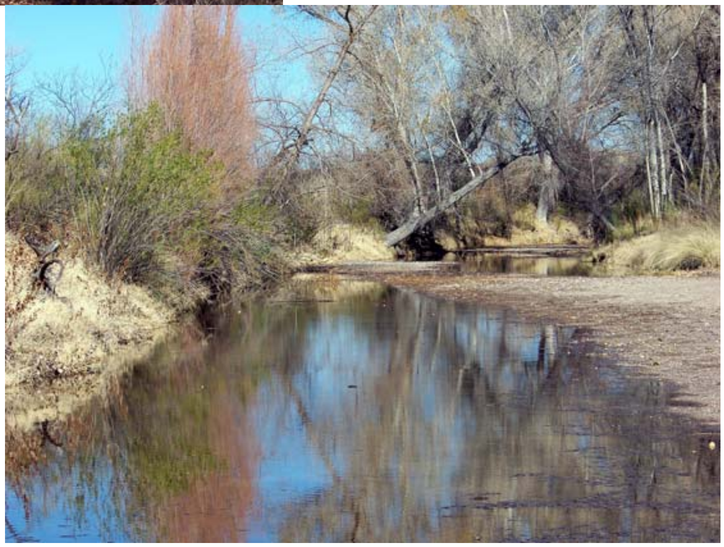
Trans Pecos Water Trust
Alamito Creek Preserve

The Dixon Water Foundation recently donated a tract of land to the Trans Pecos Water Trust (TPWT), a not-for-profit 501.c.3 corporation. The 1,061-acre donated property, designated as the Trans Pecos Water Trust Alamito Creek Preserve, includes a 3.5-mile riparian zone of Alamito Creek and a shorter segment of Matonoso Creek. The southern downstream boundary of this property is located where TX 169, also known as Casa Piedra Road, bridges Alamito Creek, approximately 35-40 miles south of Marfa in Presidio County. The 3.5-mile segment of Alamito Creek within the Preserve boundary is recommended by the FWTWPG as an " Ecologically Unique River and Stream Segment".

The Far West Texas Water Plan previously included a downstream stretch of Alamito Creek that flows within the boundary of the Big Bend Ranch State Park (see Section 4.3.4 above). The portion of Alamito Creek that separates the TPWT Preserve segment from the Big Bend Ranch State Park segment is privately owned and is not a part of this recommendation.

Alamito Creek runs on the surface for most of the TPWT Preserve stretch. There are pools with year round populations of endemic fish, amphibians and aquatic invertebrates. Alamito Creek supports an extensive cottonwood *bosque*. Ash and willow species are present. There is very little tamarix/salt cedar. The segment offers superb wildlife habitat, natural diversity, and perennial stream flow, deserving recognition as an ecologically unique stream segment.

The Dixon Water Foundation property of approximately 8,000 acres was formerly the Kennedy Ranch. The TPWT parcel is being donated with restrictions to be managed in perpetuity as a preserve. The rest of the former ranch will be offered for sale in 300-800 acre parcels with stringent conservation easements to be donated to and managed by the TPWT.



Alamito Creek Segment of the Trans Pecos Water Trust Alamito Creek Preserve

LBG-GUYTON ASSOCIATES

APPENDIX 8F

TEXAS PARKS AND WILDLIFE

RECOMMENDED ECOLOGICALLY

SIGNIFICANT RIVER AND STREAM SEGMENTS

APPENDIX 8F

Texas Parks and Wildlife Recommended Ecologically Significant River and Stream Segments

Alamito Creek - From the confluence with the Rio Grande in Presidio County upstream to the FM 169 crossing in Presidio County.

High water quality/exceptional aquatic life/high aesthetic value: ecoregion stream; diverse benthic macroinvertebrate and fish communities (Bayer et al., 1992; Linam et al., 1999)

Threatened or endangered species/unique communities: Conchos pupfish (Fed.SOC/St.T), Chihuahua shiner (Fed. SOC/St.T), Mexican stoneroller (Fed.SOC/St.T) (Bayer et al., 1992)

Cienega Creek - From the confluence with Alamito Creek upstream to its headwaters in Presidio County.

Biological function: intact desert spring ecosystem displays significant overall habitat value (D. Riskind, 1999, pers. comm.)

Riparian conservation area: Big Bend Ranch State Park

Threatened or endangered species/unique communities: Big Bend mud turtle (St.E) and endangered desert fishes (D. Riskind, 1999, pers. comm.)

Independence Creek - From the confluence with the Pecos River 15 miles south of Old Fort Lancaster and Sheffield in Terrell County upstream to its headwaters located 18 miles southwest of Sheffield in Terrell County.

Riparian conservation area: Chandler Ranch

High water quality/exceptional aquatic life/high aesthetic value: ecoregion stream; high water quality, diverse benthic macroinvertebrate community (Bayer et al., 1992)

Threatened or endangered species/unique communities: proserpine shiner (SOC/St.T), Rio Grande darter (SOC/St.T) (Linam and Kleinsasser, 1996; Linam et al., 1999)

Little Aguja Creek - From the confluence with Toyah Creek 2.5 miles southwest of Toyahvale at the Jeff Davis/Reeves County line upstream to its headwaters in the Davis Mountains 10 miles northwest of Fort Davis in Jeff Davis County.

Threatened or endangered species/unique communities: Rio Grande chub (SOC/St.T) (Hubbs et al., 1991); only known location of Little Aguja pondweed (D. Sullivan, 1998, pers. comm.)

Pecos River - From the Val Verde/Terrell County line upstream to the Terrell/Crockett/Pecos County line (within TNRCC classified stream segment 2311).

Biological function: Texas Natural Rivers System nominee for outstandingly remarkable fish and wildlife values (NPS, 1995)

High water quality/exceptional aquatic life/high aesthetic value: exceptional aesthetic value (NPS, 1995)

Threatened or endangered species/unique communities: proserpine shiner (SOC/St.T) (Hubbs et al., 1991; Linam and Kleinsasser, 1996)

Phantom Springs (Jeff Davis County)

Riparian conservation area: Managed by the Texas Parks and Wildlife Department through an agreement with the Bureau of Land Management

Threatened or endangered species/unique communities: Comanche Springs pupfish (Fed.E/St.E), Pecos gambusia (SOC/St.T) (Hubbs et al., 1991)

Rio Grande - From a point 1.1 miles downstream of the confluence of Ramsey Canyon in Val Verde County to the confluence of the Rio Conchos (Mexico) in Presidio County (TNRCC stream segment 2306).

Riparian conservation area: Big Bend National Park; Big Bend Ranch State Natural Area; National Wild and Scenic River

High water quality/exceptional aquatic life/high aesthetic value: diverse benthic macroinvertebrate community (J. Davis, 1998, pers. comm.)

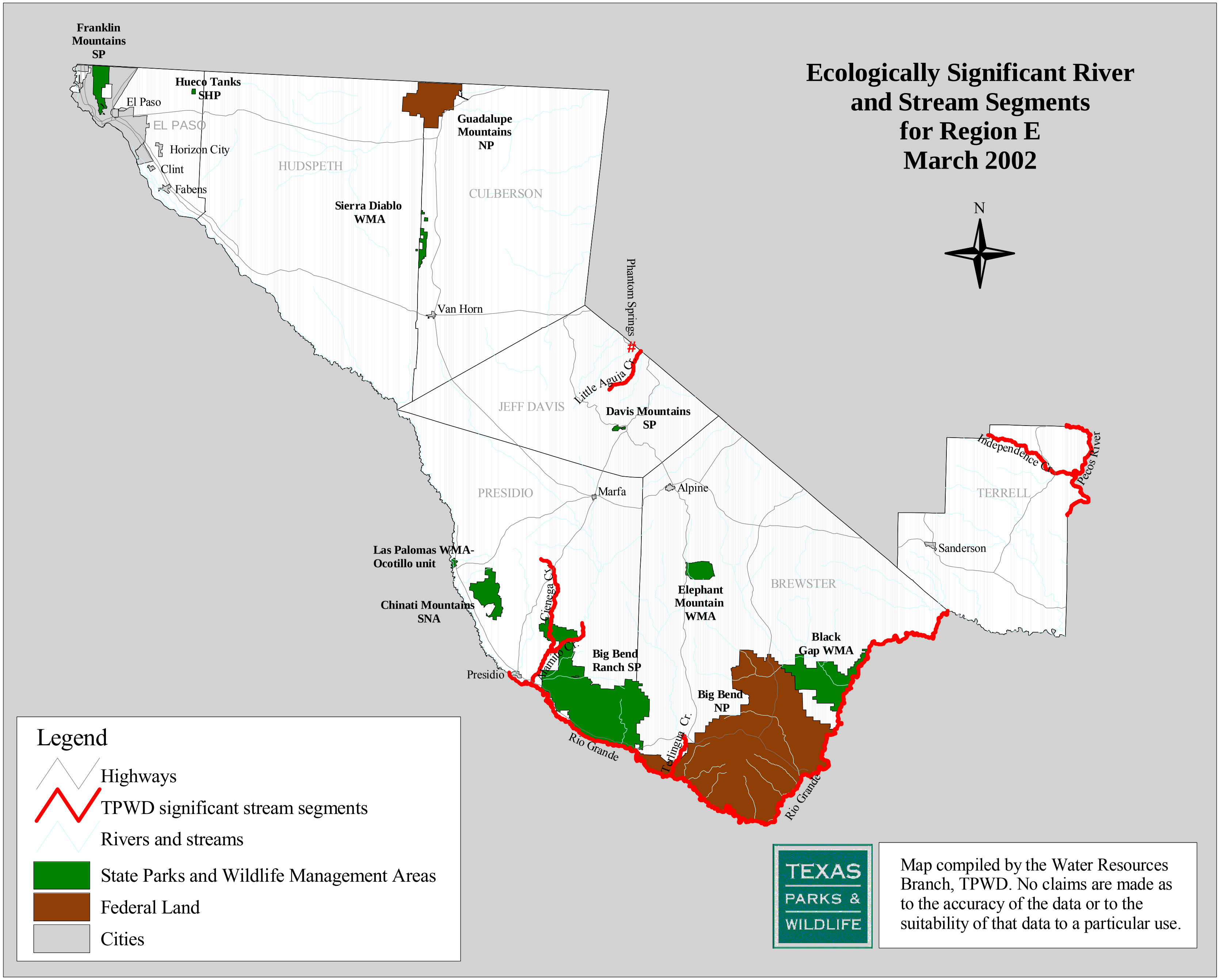
Threatened or endangered species/unique communities: Occurrence of species or habitat insufficient to merit designation.

Terlingua Creek - From the confluence with the Rio Grande two miles south of Terlingua Abaja in Brewster County upstream to the FM 170 crossing in Brewster County

Riparian conservation area: Big Bend National Park

High water quality/exceptional aquatic life/high aesthetic value: ecoregion stream (Linam et al., 1999); exceptional aesthetic value (NPS, 1995)

Threatened or endangered species/unique communities: proserpine shiner (SOC/St.T) (Linam et al., 1999)


Ecologically Significant River and Stream Segments for Region E March 2002
N
Franklin Mountains SP
Hueco Tanks SHP
El Paso
EL PASO
Horizon City
Clint
Fabens
HUDSPETH
Sierra Diablo WMA
Guadalupe Mountains NP
CULBERSON
Van Horn
Phantom Springs
Little Aguja Cr.
JEFF DAVIS
Davis Mountains SP
PRESIDIO
Marfa
Alpine
Las Palomas WMA-Ocotillo unit
Chinati Mountains SNA
Cienega Cr.
Alamito Cr.
Big Bend Ranch SP
Presidio
Rio Grande
Elephant Mountain WMA
BREWSTER
Big Bend NP
Terlingua Cr.
Black Gap WMA
Rio Grande
TERRELL
Sanderson
Independence Cr.
Pecos River
Legend
Highways
TPWD significant stream segments
Rivers and streams
State Parks and Wildlife Management Areas
Federal Land
Cities
TEXAS PARKS & WILDLIFE
Map compiled by the Water Resources Branch, TPWD. No claims are made as to the accuracy of the data or to the suitability of that data to a particular use.

CHAPTER 9

WATER INFRASTRUCTURE FUNDING

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9.1 INTRODUCTION

Between June 11 and August 6, 2010, 4 wholesale water providers or water suppliers, representing 11 water user groups, were surveyed by the Rio Grande Council of Governments on behalf of the Far West Texas Water Planning Group. These entities have a projected water supply deficit and recommended strategies to meet that need, or they have an identified need for a water supply infrastructure project which will require state financial assistance. Every entity surveyed submitted responses. Survey responses summarized here include those of the El Paso Water Utilities, Horizon Regional MUD, El Paso County Tornillo WID and the City of Marfa. 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 *2011 Far West Texas Water Plan*. Entities and water user groups with zero-capital-cost strategies were not surveyed.

Unlike infrastructure financing surveys conducted for previous regional water plans, questions during this planning cycle focused on projected needs for financial assistance from 5 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 funding needs to the state legislature.   No additional, regionally-specific questions were included in this planning cycle's survey.

9.2 STATE WATER PLAN FUNDING

The TWDB offers financial assistance for the planning, design and construction of projects identified in the regional water plans or State Water Plan. Programs available include the State Participation Fund (SP), the Water Infrastructure Fund (WIF) 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 plan or State Water Plan.

In 2007 the 80^{th} Texas Legislature appropriated funding to enable the issuance of $812 million in bonds for water plan projects, an amount estimated to meet water supply needs identified in the 2007 State Water Plan through 2020. The results of the current surveys carried out by each of the planning regions will be used to identify the amount of additional funds that will be needed for water supply projects through the end of the 2060 planning horizon.

9.3 TWDB FUNDING PROGRAMS AVAILABLE

9.3.1 Water Infrastructure Fund (WIF)

The Water Infrastructure Fund (WIF) provides subsidized interest rate loans for planning, design and construction. For projects that have a long lead time for development costs, a portion of the WIF is available specifically for planning, design, permitting and other costs associated with state or federal regulatory activities. This WIF-Deferred fund offers the option of deferring all interest and principal payments for up to 10 years or until the end of project construction.

9.3.2 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. On new water supply projects, the TWDB can fund up to 80% of the costs, provided that the applicant can fund the other 20% through an alternate source and that at least 20% of the total capacity of the project serves current needs.

9.3.3 Rural and Economically Distressed Areas (EDAP)

Both grants and 0% 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.

9.4 THE INFRASTRUCTURE FINANCING SURVEY

The survey coordinated by the Rio Grande Council of Governments asked for a response to two questions required by the TWDB. The surveys were conducted online, with a unique URL address supplied to each surveyed entity. Each survey instrument was 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 (WIF, SP and EDAP) were summarized, and the survey participant was asked to identify the amounts they would like to receive from each funding source for each identified project or strategy.

The surveys listed each recommended strategy and its total capital cost. Following this basic data, the water user group or wholesale water provider was asked: 1) the amount to be requested from each TWDB funding source; and 2) the earliest date the funds would be needed, by fund type. The Far West Texas Water Planning Group did not add any additional, region-specific questions to the survey during this planning cycle.

Political subdivisions of the state whose water supply strategies were noted in the regional plan as having zero capital costs were not surveyed (see Table 4-2). In the Far West Texas Water Planning Region, the communities of San Elizario, Socorro and Vinton, the Lower Valley Water District and Fort Bliss water supply entities, and the county aggregate water user groups of El Paso County Other, El Paso County Manufacturing and Steam Electric Power Generation, have identified needs in the adopted regional water plan. However, the water management strategies recommended to meet those needs do not include capital costs. The recommended strategy for all of these entities is to purchase water from a wholesale water provider: either directly from El Paso Water Utilities, or from the Lower Valley Water District, which in turn purchases water from El Paso Water Utilities. Therefore, these communities and water user groups were not surveyed. Where a water user group with needs and strategies to meet those needs have multiple water management strategies, some of which have capital costs and others which have no capital costs, those water user groups were only surveyed for the strategies with a capital cost.

Surveys were completed online between June 11 and August 6, 2010. Several entities were surveyed twice, in order to update information which changed as a result of reevaluation of strategies following the submission of the Initially Prepared Plan in March 2010, through the development of additional strategies, or to correct incomplete or incorrect data.

9.5 SUMMARY OF RESPONSES TO THE SURVEY

Of the 4 entities with strategies which were surveyed, none indicated an ability to pay the entire cost of its proposed infrastructure project(s). Table 9-1 summarizes the results of the surveys.

Horizon Regional MUD indicated that it can pay the majority of the $34,344,000 cost of its strategy of drilling additional wells and expanding the capacity of its desalination plant. It will be seeking only 11% of the total capital costs of its strategy, from the WIF. Approximately 2% of the strategy capital costs will be met through the use of the WIF-Deferred option in 2011 for planning, design and permitting, and an additional 9% from WIF-Construction in 2012 to cover acquisition and construction costs.

El Paso Water Utilities indicated that it plans to pay for 25% ($492,287,747) of its expected total of $656,414,000 in capital improvements. EPWU intends to use the WIF-Deferred option for approximately 35% of the capital costs for each strategy, with the remaining 65% coming from WIF-Construction. Year of initial need for each of these sources varies by strategy, ranging from 2011 for WIF-Deferred for IWMS-Recharge of Groundwater with Treated Surface Water to 2047 for WIF-Construction for IWMS-Import from Dell Valley.

El Paso County Tornillo WID has already received $300,000 in funding from El Paso County to construct one new well, which should be completed and online by the end of 2010. The district will rely on EDAP funding to cover the remaining $706,162 cost of additional wells, and the arsenic treatment facility. The earliest date that EDAP funds will be sought is 2010, as applications have already been submitted.

The City of Marfa is seeking all of its $702,770 cost to drill a new well from the EDAP program. They have indicated that they will apply to both the EDAP and EDAP-Rural programs. Applications to both programs will be submitted before the end of 2010.

These four political subdivisions indicated that they can afford to pay a total of only 28% or $194,870,253 of their strategy costs using sources other than TWDB financial assistance programs. As in the past, the source of these additional funds is expected to include a mixture of cash reserves, bonds and federal funding programs.

In total, regional political subdivisions indicated that they intend to apply for approximately $500 million in TWDB financing to pay for their projected water infrastructure costs. Of that total, most of the funding ($496,187,747) will be sought from the WIF program. The remainder of $3,405,764 will come from EDAP, with no entity indicating an intention to use the State Participation fund. In contrast, the infrastructure financing survey conducted for the 2006 plan showed that state financing would be sought for only $27.4 million in projected regional water infrastructure costs. This huge difference in projected need for state financial assistance has significant implications for statewide budget considerations.

Table 9-1. Summary of Infrastructure Financing Options Identified in the Surveys

Political Subdivision Name	County	Plan Strat#	Project Name	TWDB Funding Type*	Capital Cost Financed by Fund	Earliest Year of Need	Total Project Capital Cost	% TWDB Financed
EL PASO	EL PASO	E-1	IWMS - DIRECT REUSE	WIF: PLANNING, DESIGN, AND PERMITTING	$ 6,620,000	2014	$ 25,257,000	75%
				WIF: ACQUISITION AND CONSTRUCTION	$ 12,300,000	2015		
				SP: EXCESS CAPACITY	$ -	2010		
				EDAP - RURAL	$ -	2010		
				EDAP - DISADVANTAGED	$ -	2010		
EL PASO	EL PASO	E-3	IWMS - RECHARGE OF GROUNDWATER WITH TREATED SURFACE WATER	WIF: PLANNING, DESIGN, AND PERMITTING	$ 3,839,062	2011	$ 14,625,000	75%
				WIF: ACQUISITION AND CONSTRUCTION	$ 7,129,687	2012		
				SP: EXCESS CAPACITY	$ -	2010		
				EDAP - RURAL	$ -	2010		
				EDAP - DISADVANTAGED	$ -	2010		
EL PASO	EL PASO	E-4	IWMS - DESALINATION OF AGRICULTURAL DRAIN WATER	WIF: PLANNING, DESIGN, AND PERMITTING	$ 4,377,187	2013	$ 16,675,000	75%
				WIF: ACQUISITION AND CONSTRUCTION	$ 8,129,062	2014		
				SP: EXCESS CAPACITY	$ -	2010		
				EDAP - RURAL	$ -	2010		
				EDAP - DISADVANTAGED	$ -	2010		
EL PASO	EL PASO	E-5	IWMS - CONJUNCTIVE USE WITH ADDITIONAL SURFACE WATER	WIF: PLANNING, DESIGN, AND PERMITTING	$ 36,812,475	2015	$ 140,238,000	75%
				WIF: ACQUISITION AND CONSTRUCTION	$ 68,366,025	2016		
				SP: EXCESS CAPACITY	$ -	2010		
				EDAP - RURAL	$ -	2010		
				EDAP - DISADVANTAGED	$ -	2010		
EL PASO	EL PASO	E-6	IWMS - IMPORT FROM DELL VALLEY	WIF: PLANNING, DESIGN, AND PERMITTING	$ 56,204,662	2045	$ 214,113,000	75%
				WIF: ACQUISITION AND CONSTRUCTION	$ 104,380,087	2047		
				SP: EXCESS CAPACITY	$ -	2010		
				EDAP - RURAL	$ -	2010		
				EDAP - DISADVANTAGED	$ -	2010		
EL PASO	EL PASO	E-7	IWMS - IMPORT FROM DIABLO FARMS	WIF: PLANNING, DESIGN, AND PERMITTING	$ 64,445,325	2035	$ 245,506,000	75%
				WIF: ACQUISITION AND CONSTRUCTION	$ 119,684,175	2037		
				SP: EXCESS CAPACITY	$ -	2010		
				EDAP - RURAL	$ -	2010		
				EDAP - DISADVANTAGED	$ -	2010		
HORIZON REGIONAL MUD	EL PASO	E-8	ADDITIONAL WELLS AND DESALINATION PLANT EXPANSIONS	WIF: PLANNING, DESIGN, AND PERMITTING	$ 650,000	2011	$ 34,344,000	11%
				WIF: ACQUISITION AND CONSTRUCTION	$ 3,250,000	2012		
				SP: EXCESS CAPACITY	$ -	2010		
				EDAP - RURAL	$ -	2010		
				EDAP - DISADVANTAGED	$ -	2010		
TORNILLO WCID	EL PASO	E-13	ADDITIONAL WELLS	WIF: PLANNING, DESIGN, AND PERMITTING	$ -	2010	$ 1,006,762	70%
				WIF: ACQUISITION AND CONSTRUCTION	$ -	2010		
				SP: EXCESS CAPACITY	$ -	2010		
				EDAP - RURAL	$ 706,762	2010		
				EDAP - DISADVANTAGED	$ -	2010		
TORNILLO WCID	EL PASO	E-23	ARSENIC TREATMENT FACILITY	WIF: PLANNING, DESIGN, AND PERMITTING	$ -	2010	$ 1,996,232	100%
				WIF: ACQUISITION AND CONSTRUCTION	$ -	2010		
				SP: EXCESS CAPACITY	$ -	2010		
				EDAP - RURAL	$ -	2010		
				EDAP - DISADVANTAGED	$ 1,996,232	2010		
MARFA	PRESIDIO	E-24	ADDITIONAL ONE WELL	WIF: PLANNING, DESIGN, AND PERMITTING	$ -	2010	$ 702,770	100%
				WIF: ACQUISITION AND CONSTRUCTION	$ -	2010		
				SP: EXCESS CAPACITY	$ -	2010		
				EDAP - RURAL	$ 702,770	2010		
				EDAP - DISADVANTAGED		2010		
				Totals:	**$ 499,593,511**		**$ 694,463,764**	**72%**

*** TWDB Funding Type Key:** **WIF = Water Infrastructure Fund**
SP = State Participation Fund
EDAP = Economically Distressed Areas Program

9.6 PROPOSED ROLE OF THE STATE IN FINANCING WATER INFRASTRUCTURE COSTS

It is clear from the survey results that there will be a significant and greatly increased need to access state funding sources to pay for the cost of water infrastructure identified in the *2011Far West Texas Water Plan.* Regional political subdivisions indicated that they will be unable to pay for approximately $500 million in projected water infrastructure costs, up from $24.7 million in the 2006 regional plan.

Increased demands on state funding sources will heighten competition for limited available funds. Having started the regional planning process in motion, the state will need to identify the means to greatly expand its role in financing the needed water supply infrastructure. Without an expansion of state assistance programs, the needs identified in the regional planning process will not be addressed. For most of the communities surveyed, data indicate that they believe it simply will not be possible to pass the costs of necessary infrastructure onto their utility customers. For most of the smaller, rural communities, the customer base is too small and/or too poor to bear that burden alone.

For both the City of Marfa and the El Paso County Tornillo WID, the EDAP program is the preferred choice, with grant funding preferable to even a 0% interest loan. They will turn to loan funds only if grants are not available. In addition to the financing programs which were the subject of this survey, additional funds might be available through the TWDB's Rural Water Assistance Fund and the State Revolving Fund. Federal lending sources include USDA Rural Utilities Service loan programs, and the North American Development Bank (NADBank). Most borrowers only turn to NADBank as a matter of last resort however, because of the high administrative burden and the length of time it takes for project completion under the program. Small, rural, and disadvantaged communities will require access to low interest loan programs and grant funding, and funds for these resources need to be increased to match the expected demand.

The State Participation Program was not identified by any water supplier in the region, as a potential source of funds. Because of the very rural nature of most of the planning region, its utility is predominantly limited to entities in El Paso County. For most of the Far West Texas Water Planning Region, the State Participation Program is simply unsuitable, because the distance between communities makes regionalization impractical. While the economies of scale that can be realized by regional systems are acknowledged, such regional systems require a density of population that only occurs within the planning region in El Paso County. The other six counties in the planning region are sparsely settled rural areas, characterized by small, widely-separated communities. Within El Paso County, however, there are opportunities for regionalization in water supply infrastructure that would make the most cost-effective use of the limited funds available.

The increased role of the state in funding water infrastructure projects identified in the *2011 Far West Texas Water Plan* will require dedicated funding sources to support both grant and loan programs. In the past, needed funds have come from a greatly expanded TWDB bonding capacity as authorized by the Texas Legislature. It is unclear whether that option alone will continue to provide all of the funds necessary to meet the State's projected needs in assisting local governments to implement the recommended strategies in the regional and state water plans.

As a result of infrastructure financing recommendations arising out of previous regional water planning cycles, the state increased its efforts to attract federal funds for needed water infrastructure projects, with the TWDB taking the lead role in this effort. The annual Texas Water Day on Capitol Hill is the most visible outgrowth of this initiative. In the current recessionary national budget climate however, such efforts may not be as fruitful as they have in the past. It is recommended that they be maintained, though, as local and regional needs persist and continue to increase.

In previous planning cycles, the Far West Texas WPG has also urged TWDB staff to assist smaller entities in identifying all available funding sources and putting together a "package" of complementary programs to cover the cost of needed infrastructure improvements. These recommendations were also implemented, and should be continued.

TWDB and other state agency programs that can be used to fund water infrastructure should be combined into funding packages, their procedures simplified or streamlined, and their rules made more flexible. Many of the small communities that need to access state funds have limited staff for project proposals and management, and often feel lost in a maze of confusing program-specific rules and regulations

CHAPTER 10

PUBLIC PARTICIPATION

AND

PLAN ADOPTION

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10.1 INTRODUCTION

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, the final chapter of the plan, 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.

10.2 REGIONAL WATER PLANNING GROUP

The TWDB appointed an initial coordinating body for Far West Texas, based on names submitted by the public for consideration. The FWTWPG then 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. 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 members of the FWTWPG are only compensated for allowable travel expenses and have voluntarily devoted considerable amounts of their time to develop the regional water plan. Current Group members and their alternates are listed in the following table:

FAR WEST TEXAS WATER PLANNING GROUP

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	Jerry Agan	Presidio	Brad Newton	Presidio
Counties	Ken Norris	Terrell	Charles Stegall	Terrell
Counties	Willie Gandara	El Paso		
Economic Develop.	Paige Waggoner	El Paso		
Environment	Carl Lieb	El Paso	Anthony Tarquin	El Paso
Elec. Generating Util.	Carlos Zuazua	El Paso	Roger Chacon	El Paso
Fort Bliss	Al Riera	El Paso		
Groundwater Dist.	Randy Barker	Hudspeth	Talley Davis	Hudspeth
Groundwater Dist.	Janet Adams	Jeff Davis	John Jones	Culberson
Industries	Ann Allen	El Paso	Allen Hains	El Paso
Legislative Rep.	Teresa Todd	Jeff Davis	Rep. Pete Gallego	Brewster
Legislative Rep.	Juana Padilla	El Paso	Sen. Eliot Shapleigh	El Paso
Municipalities	Becky Brewster	Culberson	Okey Lucas	Culberson
Municipalities	Ed Archuleta	El Paso	Scott Reinert	El Paso
Municipalities	Sylvia Borunda Firth	El Paso		
Public	Dave Hall	El Paso		
Public	Teodora Trujillo	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, 14 non-voting members were 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 adjacent to Far West Texas (Region F and Region J). The non-voting members and their alternates are listed in the following table:

Non-Voting Member	**Agency/ Organization**	**Alternate Member**	**Agency**
Raymond Bader	Texas Ag. Ext. Service		
Filiberto Cortez	USBR	Woody Irving	USBR
Trace Finley	GLO		
William Finn	IBWC		
Hector Garza	USGS	Ann Ardis	USGS
Ron Glover	Hunt NR, Ltd.		
Otila Gonzalez	Region J		
Ari Michelsen	TX AgriLife Research	Zhuping Sheng	
Adriana Resendez	CILA Mexico	Aldo Garcia	CILA Mexico
Caroline Runge	Region F		
Jack Stallings	TDA		
Billy Tarrant	TPWD	Jonah Evans	TPWD
Connie Townsend	TWDB	David Meesey	TWDB
William Wellman	Big Bend National Park	Jeff Bennett	Big Bend National Park

10.3 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 the current planning cycle, this approach was abandoned, and the entire FWTWPG worked together on the regional plan from start to finish.

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 was projected to be a key factor for the success and acceptance of the plan. Open discussion and citizen input was encouraged throughout the planning process and helped planners develop a plan that reflects community values and concerns. Some members of the public participated 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, e-mailed to an additional 350 interested parties, and 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 the scope of work for the plan. Prior to submittal of the initially prepared plan to the TWDB, a copy of the *Draft 2011 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 (**http://www.riocog.org/EnvSvcs/FWTWPG/fwtwpg.htm**) was developed that 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 within 3 - 5 days of the meeting, 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.

10.4 PRE-PLANNING MEETINGS

Prior to the development of a scope of work, two public meetings were conducted to identify a common long-range vision for the development of a regional water plan. The first public meeting was held in Marfa on February 28, 2008, a second meeting was held at the Texas AgriLife Research Center in El Paso on April 24, 2008. The intent of the public meetings was to explain the planning process, introduce the planning group members, and receive comments and recommendations regarding the proposed Scope of Work. The public was also updated on the progress of region-specific special studies at these meetings. The results of those interim studies have been incorporated into this regional plan.

10.5 PUBLIC PRESENTATIONS AND FIELD TRIPS

One field trip and several presentations were provided specifically to increase public awareness of the planning process and to engage public input where possible. Participation in these activities by both planning group members and the public served to broaden their knowledge of both regional issues and local conditions in a geographically diverse planning region. In addition, the working conference mandated by SB 1762 (80th Texas Legislative session) to examine the impacts of climate change on surface water supplies from the Rio Grande, was also conducted during the planning period. The results of that conference, which was well attended by both planning group members and the public, are incorporated into the current plan. Meetings and field trips of specific interest to the public included the following:

- Public SOW meeting – Marfa, February 28, 2008
- Public SOW meeting – El Paso, April 24, 2008
- Conference on the impact of climate change on surface water deliveries from the Rio Grande – El Paso, June 18, 2008
- Public meeting to take comments on interim studies – Alpine, November 13, 2008
- Field Trip – Kokernot Spring, Alpine, November 13, 2008
- Public meeting to review and approve submittal of final interim studies reports – El Paso, July 1, 2009
- New member and public training on regional water planning – Alpine, December 3, 2009

10.6 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 El Paso, where adequate facilities could be arranged. During the current planning cycle, meetings were predominately held in various locations in El Paso County, as well as in Alpine (Brewster County), Marfa (Presidio County) and Dell City (Hudspeth County).

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)

One final public hearing was held in Van Horn on April 8, 2010 to receive comments on the Initially Prepared Plan (IPP). Responses to all comments are included in this chapter as Appendix 10A (public hearing and written comments), Appendix 10B (TPWD letter) and Appendix 10C (TWDB comments).

Copies of the IPP were available by March 1, 2010 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 2011 Far West Texas Water Plan was adopted by the FWTWPG on August 19, 2010 and the Plan was delivered to the TWDB by September 1, 2010.

10.7 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.

10.8 PLAN IMPLEMENTATION

Following final adoption of the *2011 Far West Texas Water Plan*, copies of the Plan will be 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

RESPONSES TO PUBLIC COMMENTS

Initially Prepared Plan
Public Hearing, 1:00 PM, April 8, 2010
Van Horn Convention Center & Visitor's Bureau
Summary of Public Hearing & Public Comment Received

Tom Beard, Chairman, Far West Texas Water Planning Group
Mr. Beard welcomed everyone and summarized the planning process and the objectives of the current plan, which is focused on updating the plan only where conditions have changed or new data needs to be incorporated to update the plan. He asked for the members of the public in attendance to provide oral comments at the hearing, or to submit written comments on the draft plan.

John Ashworth, Project Manager, LBG-Guyton Associates
Mr. Ashworth summarized the main changes to the 2006 plan, and stressed that every comment received from either a member of the public, or the state agencies who are also reviewing the plan, would be summarized and addressed in the final plan, which will be submitted to the Texas Water Development Board by September 1, 2010. The main change to the plan which he highlighted is the change in one of El Paso's set of integrated strategies: the importation of water from Diablo Farms is now projected to start in 2040 rather than in 2050. In addition, several new stream segments have been recommended as being ecologically unique. He also noted where the results from the interim studies performed during the current planning cycle will be integrated into the regional plan.

Connie Townsend, Regional Planner, Texas Water Development Board
Ms. Townsend provided an historic overview of regional water planning in Texas, focusing on the change from top-down to bottoms-up planning, which was designed to encourage local buy-in and consensus regional solutions. The planning process and the legislative process are closely linked, as the legislature uses the state and regional plans to decide funding priorities. With an expanding population, the state needs to look ahead at issues, problems and potential solutions.

Kevin Lynch, Hudspeth County
Mr. Lynch asked for more information on Chapter 9, the Infrastructure Financing Survey, and questioned why the chapter was not completed in the IPP. Mr. Ashworth replied that the chapter would not be completed until after the submittal of the IPP. A survey of all entities with identified future needs would be sent out in approximately one month and the results from that survey would be included as Chapter 9. Mr. Beard added that if a water supply entity needs funding for a water infrastructure project, then it must be included in the plan. Every strategy that is recommended is already included in the plans of the local water supply entities.

Pat Baker, Terrell County

Mr. Baker commented that few landowners in Terrell County know about the planning process, and questioned why no Terrell County members of the planning group were present at the public hearing. Mr. Beard noted that this planning cycle was limited to updating the 2006 plan; more will be happening in the next planning cycle when the 2010 census data will be available. While the Terrell County members are not here today, they are very active on the group and involved in the planning process. He explained that this is a public hearing to take public comment on the plan, not a regular meeting of the planning group where a quorum of members is expected to attend. Mr. Baker will be added to the list of interested parties, which receive email updates about regional water issues and the water planning process.

APPENDIX 10B

TEXAS PARKS AND WILDLIFE DEPARTMENT LETTER

TEXAS PARKS & WILDLIFE

Life's better outside.®

June 3, 2010

Mr. Tom Beard, Chairman
Far West Texas Regional Water Planning Group
1100 N. Stanton St., Suite 610
El Paso, TX 79902

Re: 2010 Far West Texas Regional Water Planning Group Initially Prepared Plan

Dear Mr. Beard:

Thank you for the opportunity to review and comment on the 2010 Initially Prepared Regional Water Plan (IPP) for Far West Texas Region E. Texas Parks and Wildlife (TPW) acknowledges the time, money and effort required to produce the regional water plan as mandated by Senate Bill 1 of the 75th Legislature. A number of positive steps have been taken since the first planning cycle to advance the issue of environmental protection. For example, the regional water planning groups are required by TAC §357.7(a)(8)(A), to perform a "quantitative reporting of environmental factors including effects on environmental water needs, wildlife habitat, cultural resources, and effect of upstream development on bays, estuaries, and arms of the Gulf of Mexico" when evaluating water management strategies (WMS). Quantification of environmental impacts is a critical step in planning for our state's future water needs while also protecting environmental resources.

TPW staff has reviewed the IPP with a focus on the following questions:

- Does the plan include a quantitative reporting of environmental factors including the effects on environmental water needs, and habitat?
- Does the plan include a description of natural resources and threats to natural resources due to water quantity or quality problems?
- Does the plan discuss how these threats will be addressed?
- Does the plan describe how it is consistent with long-term protection of natural resources?
- Does the plan include water conservation as a water management strategy? Reuse?
- Does the plan recommend any stream segments be nominated as ecologically unique?
- If the plan includes strategies identified in the 2006 regional water plan, does it address concerns raised by TPW at that time?

The Far West Texas IPP does a good job in recognizing that providing sufficient water for recreation and habitat in Far West Texas is critical to the long-term economic health of the region and in highlighting the importance of maintaining water for the environment. TPW understands that balancing the needs of people and the environment is a difficult task, especially in areas as water scarce as Far West Texas. The number of strategies available to meet the region's needs are limited, and ascertaining the environmental impacts can be difficult. Other than estimating terrestrial impacts, the IPP generally provides narrative descriptions of environmental effects from the selected

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www.tpwd.state.tx.us

water supply strategies rather than a quantitative reporting of the impacts. This is due to the nature of the proposed strategies which rely largely on water conservation, reuse, reallocation, conjunctive use of surface and groundwater supplies, and groundwater sources. The IPP indicates that most of the preferred water supply strategies are environmentally neutral. This is highlighted in the assessment of environmental impacts shown in Table 4.4. While it may be intuitive that several of the strategies will have limited impacts, data or references would be helpful to support the table.

Potential reductions in surface water habitats are mentioned, but a quantitative connection between potential reductions in instream and spring flows and habitat and biota is lacking. An exception is the identification of a specific flow value for the Rio Grande at the IBWC gage immediately downstream of Presidio and the confluence of Alamito Creek of 250 cfs for meeting minimum recreational, agricultural, and habitat needs. It would be instructive to know how this value was derived and whether or not similar flow values have been calculated at other locations in the region.

TPW appreciates that the IPP addresses springs and the continuation of spring flow in the region. Appendix 1-E of the IPP includes a good summation of the region's major springs and seeps that occur on state, federal, or privately owned conservation properties. However, if 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. TPW's concerns regarding spring flow and future groundwater levels are somewhat ameliorated by the planning group's goal to assess groundwater source availability based on not significantly lowering water levels to a point where spring flows might be impacted.

TPW commends the Far West Texas Regional Planning Group for once again nominating several stream segments as ecologically unique. TPW stands ready to provide any additional supporting information necessary to designate these segments as unique.

Thank you for your consideration of these comments. Please be assured that TPW will continue to work with the Far West Texas Region E to explore all possibilities to meet future water supply needs and assure the ecological health of the region's aquatic resources. Please contact Cindy Loeffler at (512) 389-8715 if you have questions or concerns.

Sincerely,

Ross Melinchuk
Deputy Executive Director, Natural Resources

RM:CL:ms

APPENDIX 10C

RESPONSES TO TWDB COMMENTS

APPENDIX 10C

Responses to TWDB Comments on the Initially Prepared 2011 Region E Regional Water Plan

Chapter 1

1. Pages 1-16 and 2-2: Please describe in the plan the occurrence and impact of the Fort Bliss military population increase for the associated water user group (City of El Paso). Please also describe in the plan the evaluation of this population and its impact on water demand for the City of El Paso. *[Contract Exhibit "A" Tasks 1.3 and 2.5]*

Response: Discussion added in Sections 1.3.3 and 2.2.

The greatest increase to population in the Region is associated with the Fort Bliss Military Base. According to information provided by Fort Bliss, there are now 19,300 soldiers stationed at the base, and by 2018, current plans call for having 33,470 soldiers stationed at the base. There are now 20,820 people living on the base, and current plans call for this to increase to 27,630 by 2018. This current 2011 Plan projects an increase of approximately 4,000 acre-feet of water use by Fort Bliss in the year 2020 over what was projected in the previous 2006 Plan. The new El Paso-Fort Bliss Kay Bailey Hutchison Desalination Facility will generate a new supply of water to assist in meeting this increased need.

2. Pages 1-16 through 1-19, Section 1.3.3: Please include in the plan results of the investigation and evaluation of water demands due to the potential 1,000 bed expansion of the prison in Sierra Blanca and the potential biodiesel plant in Presidio County. *[Contract Exhibit "A" Task 1.14]*

Response: Explanation provided at end of Section 1.3.3.

Following the 2006 Far West Texas Water Plan submittal, there appeared to be the potential for increasing water needs in the Region as generated by an anticipated 1,000-bed expansion of the prison in Sierra Blanca and the construction of a biodiesel plant in Presidio County. As of the printing of this Plan, neither of these projects has occurred.

3. Section 1.6: Please include in the plan a description of the current preparations for drought in Region E. *[Title 31 Texas Administrative Code (TAC) §357.7(a)(1)(H)]*

Response: Discussion added in Section 1.6.2.

> *El Paso Water Utilities (EPWU) 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 EPWU and the irrigation districts in El Paso and Hudspeth Counties are also in place.*

<u>Chapter 3</u>

4. Please describe how water availability requirements or limitations associated with the El Paso County Priority Groundwater Management Area, if any, were considered in developing the regional water plan. *[31 TAC §357.5(k)(1)(G)]*

Response: Description provided as fifth bullet in Section 3.1.

> *No availability requirements or limitations 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 Section 1.6.3).*

5. Section 3.1: Please clarify in the plan whether water supplies based upon contracts were assumed to be renewed, if they expire during the planning horizon. *[31 TAC §357.7(a)(3)(E); Contract Exhibit "C" Section 3.0]*

Response: Discussion provided as sixth bullet in Section 3.1.

> *Water supplies based upon contracts are assumed to be renewed if they expire during the planning horizon.*

6. Section 3.2.7, page 3-18: Please include in the plan the results regarding evaluation of the current efforts, reports, and recommendations pertaining to the "Forgotten River" project. *[Contract Exhibit "A" Task 3.7]*

Response: Results are provided in Section 3.2.7.

> *To have a meaningful impact over much of the study area, a systematic watershed approach is needed. With the reach serving as an international boundary, this would necessarily involve coordination and cooperation between the two nations to be most effective, as well as with the various regulatory and operating agencies. The primary ingredient for affecting significant environmentally beneficial change is effectively managing the water resource. Essential to this is a better understanding of the existing regime, coupled with predictive modeling to evaluate alternative scenarios to inform water managers of the most efficient usage of a scarce resource. The first step should be a meaningful water budget to quantify anticipated water*

volume, as well as identify/quantify depletions. Volume determination would aid in the evaluation of the reach's response to variations in timing, magnitude, and duration; while depleting elements could be evaluated for modification/ enhancement.

Additional detail is provided in Section 3.2.7

7. Section 3.3.4, page 3-22: Please include in the plan the findings of the updated study published in 2008 for the "Pecos River Basin Assessment" project. *[Contract Exhibit "A" Task 3.8]*

   Response: Results are provided in Section 3.3.4.

   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.

8. Page 3-24, line 1: Appendix 3A is referenced on page 3-24 as containing the results of the identification and survey of new well data for the Marathon and the Edwards-Trinity (Plateau) aquifers, but appears to be missing in the plan. Please include Appendix 3A in the plan. *[Contract Exhibit "A" Tasks 3.9 and 3.10]*

   Response: Appendix 3A is provided. Reference to website availability is provided.

   The entire report can be viewed at http://www.riocog.org/EnvSvcs/FWTWPG/publishe.htm.

9. Page 3-41, untitled table: Please confirm whether this table was updated to conform to Region F water supply source tables. *[Contract Exhibit "A" Task 3.4]*

   Response: Exported groundwater as documented by the JDCUWCD was reported to Region F. It is not known at this time how Region F will adapt to this information.

Chapter 4

10. Please confirm that all plan capital costs were updated to September 2008 dollars. *[Contract Exhibit "C" Section 4.1.2]*

Response: Statement provided in footnote of Table 4-3 and in last paragraph of Section 4.3.

Footnote: Total Capital Cost are estimated based on September 2008 US dollars.

Cost evaluations for all strategies (Table 4-3) include capital cost, debt service, and annual operating and maintenance (O&M) expenses. Capital costs are estimated based on September 2008 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.

11. Please provide a list of potentially feasible water management strategies that were considered and evaluated by the planning group. *[Contract Exhibit "C" Section 11.1]*

Response: List is provided in Tables 4-2, 4-3 and 4-4. Explanation provided in Section 4.3.

Table 4-2 provides a comparative listing of all potentially feasible strategies that the FWTWPG subsequently recommends in total for inclusion in the 2011 Plan. No "alternative" strategies are recommended by the FWTWPG.

12. Please include tables summarizing all recommended water management strategies with associated water supplies presented by decade and capital costs. *[Contract Exhibit "C" Sections 4.3, 11.1]*

Response: Data provided in Tables 4-2 and 4-3.

Table 4-2 provides a comparative listing of all potentially feasible strategies that the FWTWPG subsequently recommends in total for inclusion in the 2011 Plan. No "alternative" strategies are recommended by the FWTWPG.

13. Please include a table listing alternative strategies, if alternative water management strategies were included. *[Contract Exhibit "C" Sections 4.3, 11.1]*

Response: No alternative strategies are recommended. Statement provided in Section 4.3.

No "alternative" strategies are recommended by the FWTWPG.

14. Please describe in the plan the development of alternative strategies for entities that are anticipating changed conditions and that are potentially eligible for the State Water Infrastructure Fund funding program, including the communities of Van Horn and Sierra Blanca. *[Contract Exhibit "A" Tasks 4.4 and 4.8]*

Response: No alternative strategies were developed. Statement provided in Section 4.3

No "alternative" strategies are recommended by the FWTWPG.

15. Please describe in the plan how water conservation practices were considered for each of the 12 water user groups with identified water needs. Also, please describe the specific conservation practices recommended, if any, for each water user group with identified water needs. *[31 TAC §357.7(a)(7)(A) and §357.14(2)(B)]*

Response: El Paso and other entities that are serviced by EPWU are covered under Conservation Strategy E-2 (see Section 4.4.2). Sections 4.61 and 4.62 explain that due to Horizon's and Tornillo's water use per capita being significantly lower than the state average, no conservation strategy was considered necessary.

16. Please provide in the plan a description of the costing methodology used in the evaluation of all potentially feasible water management strategies. *[Contract Exhibit "C" Section 4.1.2]*

Response: Description is added to Section 4.3.

Cost evaluations for all strategies (Table 4-3) include capital cost, debt service, and annual operating and maintenance (O&M) expenses. Capital costs are estimated based on September 2008 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.

17. Please provide in the plan discussion of third party impacts from water management strategies that involve voluntary redistributions of water and moving water including from rural and agricultural areas *[31 TAC §357.7(a)(8)(G)]*

Response: Discussion is provided in Section 4.4.7.

<u>Conjunctive Use of Rio Grande and Local Groundwater:</u> Additional 20,000 acre-feet per year from the Rio Grande would be obtained after the retirement of about 5,000 acres of land from irrigation. This represents a reduction of agricultural activities in El Paso County. As population grows, many agricultural producers will make the decision to convert their property to residential, commercial or some purpose other than irrigated agriculture. This conversion is primarily the result of urbanization, not the implementation of this water management strategy. Conversion would be voluntary by lease, sale, or forbearance agreements.

<u>Bone Spring-Victorio Peak Aquifer (Dell City Area):</u> The integrated strategy would utilize the water rights for 9,500 acres of land in Hudspeth County, which would reduce irrigation activities near Dell City. The transfer to El Paso County is less than 1/3 of the maximum groundwater pumping limit. Conversion of water rights to transfer water to El Paso County would be voluntary. Some land may become unsuitable for agriculture after extensive irrigation with brackish water due to accumulation of salt in the soil, and would be retired from irrigation regardless of how much water is exported to El Paso County. It is expected that irrigators will find it economically beneficial to transfer or sell their land or water rights.

<u>Capitan Reef Aquifer</u>: EPWU owns land 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.

18. Page 4-1, Section 4.2: Presidio County is listed in the text of the plan as having been identified as water-deficient, which does not appear to match the data shown in Table 4-1, page 4-6. Please revise as appropriate.

Response: Text is corrected.

19. Pages 4-9 and 4-10, Tables 4-2 and 4-3: Recommended water management strategies E-18, E-19, E-20, E-21, and E-22 appear to be missing the following required water management strategy evaluation criteria: capital costs and annual costs. Please include an evaluation of capital and annual costs for these strategies and revise Tables 4-3 and 4-4, as appropriate, to incorporate these required elements. *[31 TAC §357.7(a)(8)(A)(i) and §357.7(a)(9)]*

Response: Tables are revised to contain the required cost elements.

20. Page 4-19, Section 4.4.4: Please provide a description of the methodology used to estimate the quantity of water to be provided by the groundwater storage and recovery water management strategy. *[Contract Exhibit "C" Section 3.1]*

Response: Strategy E-3 is revised to make it clearer that the 5,000 acre-feet supply consists of 3,000 acre-feet of the injected 5,000 acre-feet of treated surface water plus 2,000 acre-feet of original Hueco Bolson Aquifer groundwater.

21. Page 4-25, Section 4.4.10: Please describe in the plan how the cost of implementing the $1,000,000/yr annual conservation program for the City of El Paso was developed. *[Contract Exhibit "C" Section 4.1.2]*

Response: Explanation is provided in Section 4.4.9.

> *The cost for the conservation program is expected to be $1,000,000 per year, which is the cost experienced by EPWU in recent years. The conservation savings shown in Table 4-2 are based on a continuation of current EPWU programs and policies.*

22. Page 4-28, Section 4.5.1, first paragraph: Please reconcile the text reference to "2010" with the "2020" listed in the associated Table 4-1.

Response: Year 2010 is replaced with 2020.

Chapter 6

23. Please include a summary of information regarding water loss audits specific to Region E. *[TAC 31§ 357.7 (a)(1)(M)]*

Response: Discussion added as Section 6.1.4.

> *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. A summary of the first audit, An Analysis of Water Loss as Reported by Public Water Suppliers – 2007 (http://www.twdb.state.tx.us/RWPG/rpgm_rpts/0600010612_WaterLossinTexas.pdf) was provided to the Far West Texas Water Planning Group (FWTWPG) for consideration in developing water supply management strategies. The report lists utilities in Region E (Far West Texas) as having the lowest average value of nonrevenue water (approximately $14 per connection per year) of all 16 regions in the state. The FWTWPG acknowledges the value of this important planning tool, but identified apparent errors in some of the data. The report does offer the recognition that "as utilities refine their water audits, reducing balancing adjustments and improving real loss estimates, it is expected that water loss data reported from the next round of water audits will be more useful for planning purposes than the current water loss data. Based on this concern, the FWTWPG chose to not use the supplied data for this current Plan, but looks forward to the next improved water loss audit survey.*

24. Section 6.1: Please provide in the plan a specific discussion of the results of El Paso Water Utility's conservation outreach interim project, including reference to Appendix 1D. *[Exhibit "C" Guidelines 11.1; Contract Exhibit "A" Task 6.1]*

Response: Discussion added as Section 6.1.5.

> *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.*

25. Section 6.1: Please provide in the plan a specific discussion of the results of Texas A&M AgriLife Research's agricultural conservation interim project, including reference to Appendix 1A. *[Exhibit "C" Guidelines 11.1; Contract Exhibit "A" Task 6.3]*

Response: Discussion added as Section 6.1.6.

> *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.*
>
> *The overall conclusion is that very limited opportunities exist for significant additional water conservation in Far West Texas irrigated agriculture.*
>
> *The full report on the irrigation conservation analysis is available at http://www.riocog.org/EnvSvcs/FWTWPG/publishe.htm. Also a summary of the report is provided as Appendix 1A in Chapter 1 of this Plan.*

26. (Attachment B) Comments on the online planning database (i.e. DB12) are herein being provided in spreadsheet format. These Level 1 comments are based on a direct comparison of the online planning database against the Initially Prepared Regional Water Plan document as submitted. The table only includes numbers that do not reconcile between the plan (left side of spreadsheet) and online database (right side of spreadsheet). An electronic version of this spreadsheet will be provided upon request.

Response: FWTWPG consultant is working with TWDB staff to insure accuracy of DB 12 data sets.

27. *(Attachment C)* Based on the information provided to date by the regional water planning groups, TWDB has also attached a summary, in spreadsheet format, of apparent unmet water needs that were identified during the review of the online planning database and Initially Prepared Regional Water Plan. *[Additional TWDB comments regarding the general conformance of the online planning database (DB12) format and content to the Guidelines for Regional Water Planning Data Deliverables (Contract Exhibit D) are being provided by TWDB staff under separate cover as 'Exception Reports']*

    Response: FWTWPG consultant is working with TWDB staff to insure accuracy of DB 12 data sets.

General Comments

1. Please consider including table and figure titles and numbers throughout plan (e.g. tables on pages ES-5 and 1-67 and figure on page ES-4).

   Response: Changes were made where appropriate.

2. Please consider providing totals at the bottom of all tables in all instances when the total from a table is referenced within the plan text (e.g. Tables on pages ES-5 and ES-6).

   Response: Changes were made where appropriate.