Texas Water Development Board

2016 Region M Water Plan

Chapter 1: Description of Regional Water Planning Area

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Table of Contents

Figures

Tables

List of Abbreviations

BRACS	Brackish Resource Aquifer Characterization System
CONAGUA	Water Commission of Mexico
DCP	Drought Contingency Plan
DMI	Domestic, Municipal, & Industrial
DO	Dissolved Oxygen
DOR	Drought of Record
ESA	Endangered Species Act
HB4	House Bill #4
IBWC	International Boundary Waters Commission
IWRP	Integrated Water Resources Plan
LLM	Lower Laguna Madre
LRGV	Lower Rio Grande Valley
LRGVDC	Lower Rio Grande Valley Development Council
RWPG	Regional Water Planning Group
NWR	National Wildlife Refuge
SB1	Senate Bill #1
SP	State Park
STRWSP	South Texas Regional Water Supply Plan
SWIFT	State Water Implementation Fund
SWP	State Water Plan
TCEQ	Texas Commission on Environmental Quality
TWDB	Texas Water Development Board
TPWD	Texas Parks and Wildlife Department
USFWS	United States Fish and Wildlife Service
WAM	Water Availability Model
WMS	Water Management Strategy
WSC	Water Supply Corporation
WWP	Wholesale Water Provider

Chapter 1. Description of Regional Water Planning Area

1.1 Planning Background

The Texas Water Development Board (TWDB) was established in 1957 through a state constitutional amendment, and is charged with preparing a comprehensive and flexible long-term plan for the development, conservation, and management of the state's water resources. Historically, the State Water Plan had been prepared by the TWDB with input from other state and local agencies and the public. Senate Bill 1 (SB1) was enacted in 1997 by the 75th Legislature, which established a "bottom up" approach whereby State Water Plans are based on Regional Water Plans prepared and adopted by the 16 appointed Regional Water Planning Groups (RWPGs). SB1 states that the purpose of regional water planning is to:

> *"Provide for the orderly development, management, and conservation of water resources and preparation for and response to drought conditions in order that sufficient water will be available at a reasonable cost to ensure public health, safety, and welfare; further economic development; and protect the agricultural and natural resources of that particular region."*

SB1 also provides that future regulatory and financing decisions of the Texas Commission on Environmental Quality (TCEQ) and the TWDB be consistent with the current State Water Plan (SWP). In 2013 House Bill 4 (HB4) was enacted, which lends greater weight to the SWP by committing an additional funding pool to the implementation of projects recommended in the plan by way of the State Water Implementation Fund for Texas (SWIFT).

The TWDB is the state agency designated to oversee the planning effort, with Ms. Connie Townsend currently serving as the Project Manager for Region M. Each Regional Water Planning Group (RWPG) member is appointed to serve without pay, representing a range of stakeholders and act as the decision-making body for the regional water planning effort. The Rio Grande Regional Water Planning Group (Region M) members are listed in Table 1-1. The Lower Rio Grande Development Council (LRGVDC) has served as the political subdivision to administer the Regional Water Planning Grant, and Black and Veatch Corporation was selected as the prime consultant for the planning and engineering tasks required for development of the plan.

Table 1-1 Region M Water Planning Group

Interest	Name	Resident County
Public	Mary Lou Campbell, Secretary/Treasurer * City of Mercedes	Hidalgo
Counties	Joe Rathmell County Judge, Zapata	Zapata
	Humberto Gonzalez County Judge, Jim Hogg	Jim Hogg
Municipalities	Jorge Barrera Eagle Pass Water Works, Eagle Pass	Maverick
	John Bruciak Brownsville PUB, Brownsville	Cameron
	Tomas Rodriguez, Vice-Chairman * City of Laredo	Webb

Interest	Name	Resident County
Industries	Donald K. McGhee Hydro Systems, Inc., Harlingen	Cameron
Agriculture	Robert E. Fulbright, Hinnant & Fulbright, Hebbronville	Jim Hogg
	Ray Prewett Texas Citrus Mutual, Mission	Hidalgo
Environmental	Jaime Flores The Arroyo Colorado Watershed	Hidalgo
Small Business	Carlos Garza AEC Engineering, LLC, Edinburg	Hidalgo
	Nick Benavides Nick Benavides Co.	Webb
Electric Generating Utilities	Robert Pena, Jr. Texas Energy Consultants, Edinburg	Hidalgo
River Authorities	James Darling Attorney, Doctors Hospital at Renaissance, Edinburg	Hidalgo
Water Districts	Sonny Hinojosa * HCID No. 2, San Juan	Hidalgo
	Sonia Lambert CCID No. 2, San Benito	Cameron
Water Utilities	Dennis Goldsberry North Alamo Water Supply Corporation	Hidalgo
Groundwater Management Area	Armando Vela Red Sands GCD	Hidalgo
Other	Glenn Jarvis, Chairman * Attorney, McAllen	Hidalgo
	Frank Schuster * Val Verde Vegetable Co.	Hidalgo

* Executive Committee

The Regional Water Plans are updated every five years and one year after their adoption an updated SWP is released. The Regional Water Plans are based on an assessment of future water demands and currently available water supply, and include specific recommendations for meeting identified water needs through the end of a 50-year planning horizon (2020-2070 for this plan). The plans may also include recommendations regarding policy at the state and local level including environmental protection, drought response, and resource management.

1.2 The Rio Grande Regional Water Planning Area

The Rio Grande Regional Water Planning Area (Region M) consists of the eight counties along the middle and lower Rio Grande up to the river's mouth at the Gulf of Mexico (Figure 1-1). Since its settlement, this area has been tied to the Rio Grande for domestic and agricultural uses.

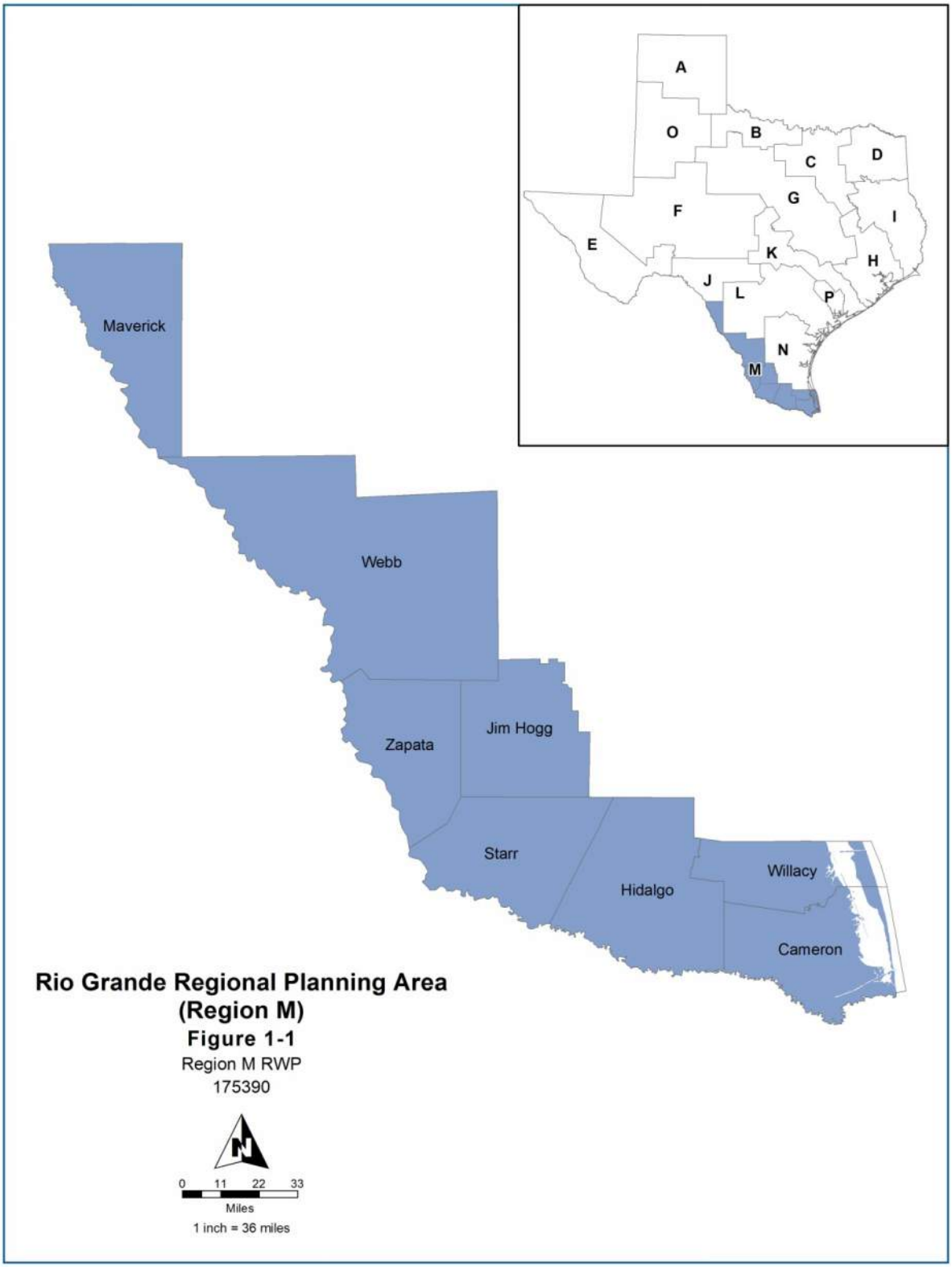

Figure 1-1 Rio Grande Regional Planning Area (Region M)

1.2.1 Climate

The climate ranges from humid sub-tropical in the eastern portion, nearest to the Gulf Coast, and drier tropical to sub-tropical in the west. The number of frost-free days varies from 320 days at the coast to 230 days in the northwestern portion of the region near Maverick County, resulting in a long growing season most years. The amount of rainfall varies across the Lower Rio Grande Region from an average of 28 inches at the coast to 18 inches in the northwestern portion of the region, mostly from thunderstorms in the spring and occasional hurricanes in the late summer and fall. These storms can generate tremendous amounts of rainfall over a short period of time causing extensive flooding due to the region's relatively flat terrain. The fall storms provide a large portion of the surface water runoff captured in water supply reservoirs within the Rio Grande Basin.

1.2.2 Population and Economy

Region M's population is concentrated in Cameron, Hidalgo, and Webb counties, accounting for 90.5% of the regional total in 2010. The US Census Bureau estimates the total population of Region M in 2013 at 1,237,942, up 4.8% from 2010 (compared with 5.2% growth statewide). Figure 1-2 shows the historical population in each county (US Census Historical Data).

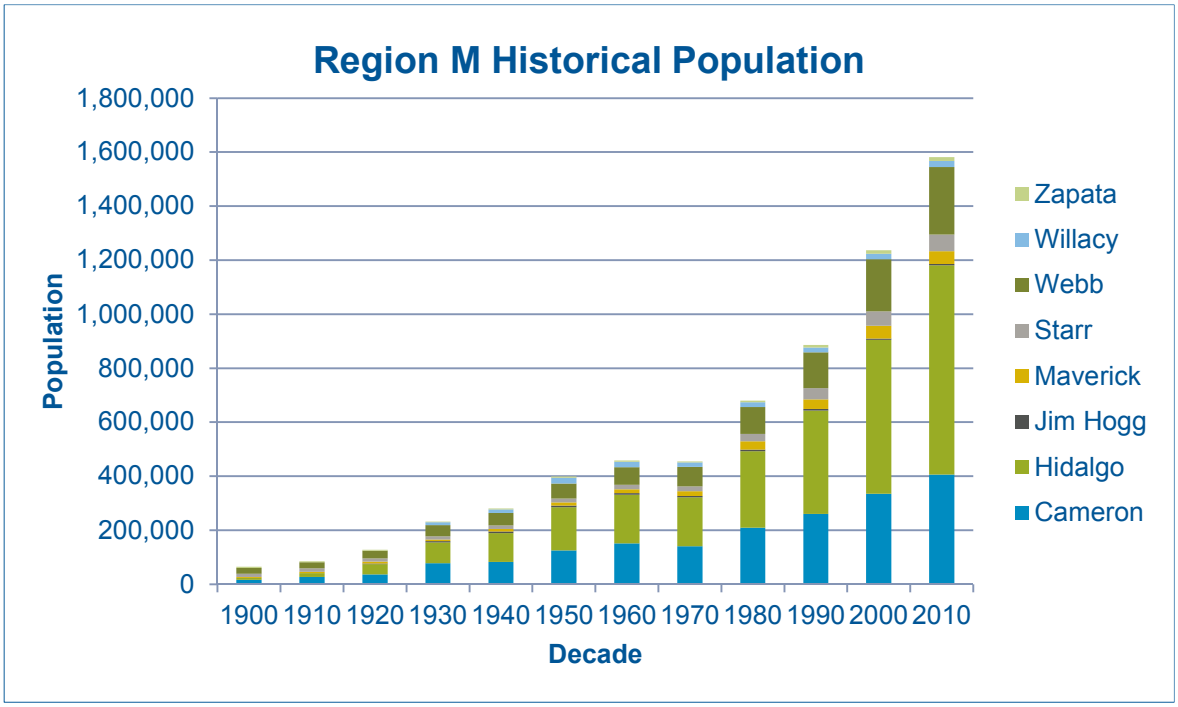

Figure 1-2 Region M Historical Population, US Census Bureau

Figure 1-3 shows current population centers in Region M. The population of the region is expected to grow to over 4 million people by the end of the current planning horizon which represents a 106% population increase from 2020 to 2070. Chapter 2 describes the population and municipal demand projections in detail.

An important factor driving rapid population growth in the Rio Grande Region is its cultural, social, and economic relationship with Mexico. Nation-wide, Mexico's population growth rate in

2013 was 1.2%, compared with 0.7% for the United States.[1] The Mexican portion of the Rio Grande (known as the Rio Bravo in Mexico) watershed was home to approximately 10.31 million people in 2005, and is anticipated to have 12.67 inhabitants by 2025, which is a higher rate of growth than the nation as a whole.[2] Using the growth rate identified by the National Water Commission of Mexico (CONAGUA) for the Rio Bravo watershed, the population in 2070 would be over 20 million people. Aquifers in Mexico's Rio Bravo Watershed are overextended, and it is clear that the growth on both sides of the border will continue to put pressure on the capabilities of both surface and groundwater.

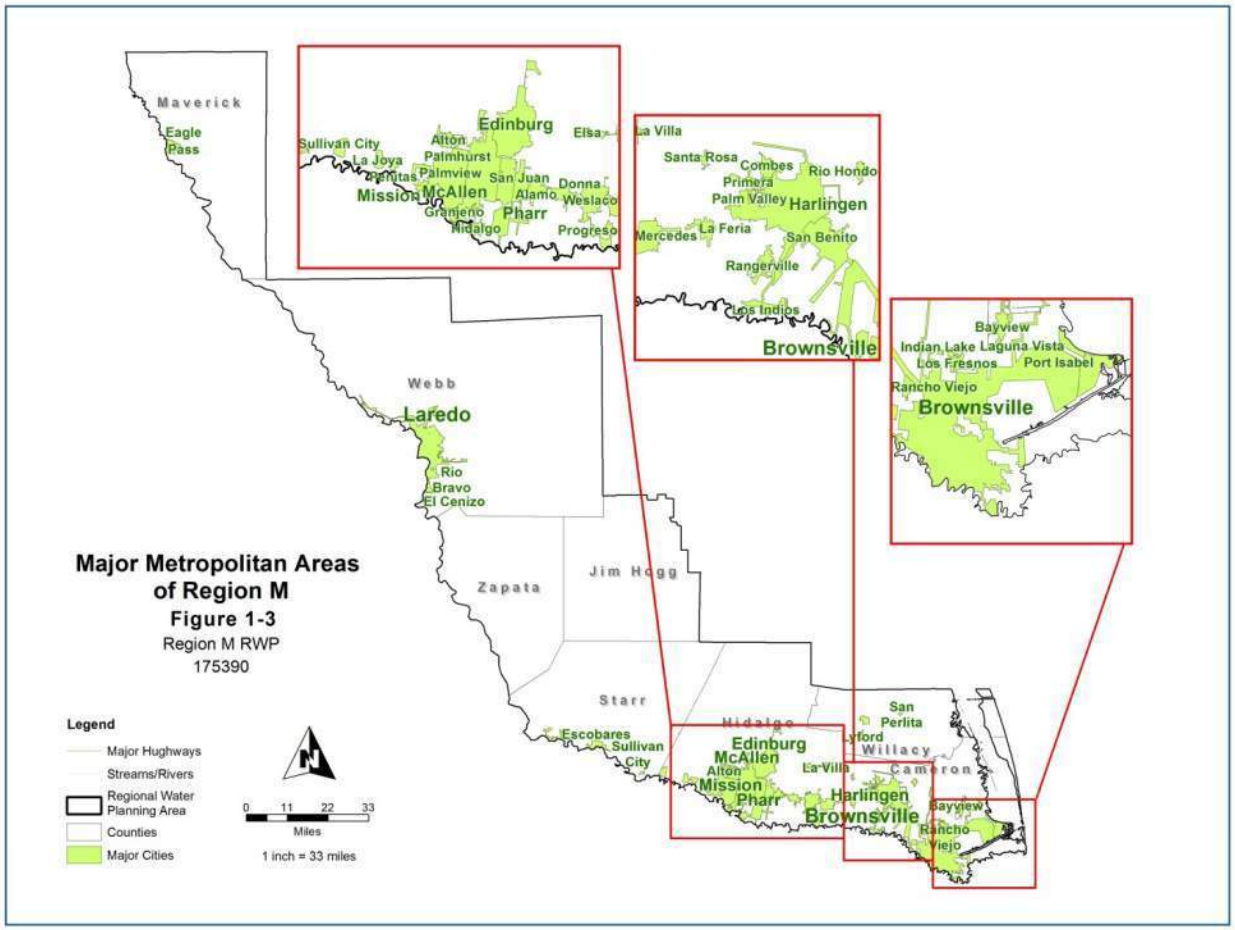

Figure 1-3 Major Metropolitan Areas of Region M

Historically, agriculture has dominated the economy of the Rio Grande Region. The increased pressure on water available for irrigation, combined with the way that water is allocated in drought years, has been difficult for farmers across the region, especially those with perennial crops and citrus or pecan trees. There is a shift toward urbanization and diversification of the

[1] World Bank Population Growth Data http://data.worldbank.org/indicator/SP.POP.GROW visited 10/10/14
[2] CONAGUA, Comission Nacional del Agua, Organizmo de Cuenca Rio Bravo, www.conagua.gob.mx/OCRB, accessed 10/29/2014.

economy, but agriculture still plays a major role in the region. The Texas labor market forecasts projected between 2012 and 2015 show growth in the Lower Rio Grande associated with health care services, administration, service industry, professional, scientific, and technical services, as well as local government.

The 2012 USDA Census of Agriculture lists the total pre-tax income from farm-related sources as $47.57 Million for Region M, of $1.35 Billion across Texas. Grain sorghum, sugarcane, cotton, citrus, and onions make up the bulk of the agriculture receipts in the region, centered in Hidalgo and Cameron Counties (Figure 1-4). Cattle and farmland accounted for less than six million acres, almost 80% of the region's land area.

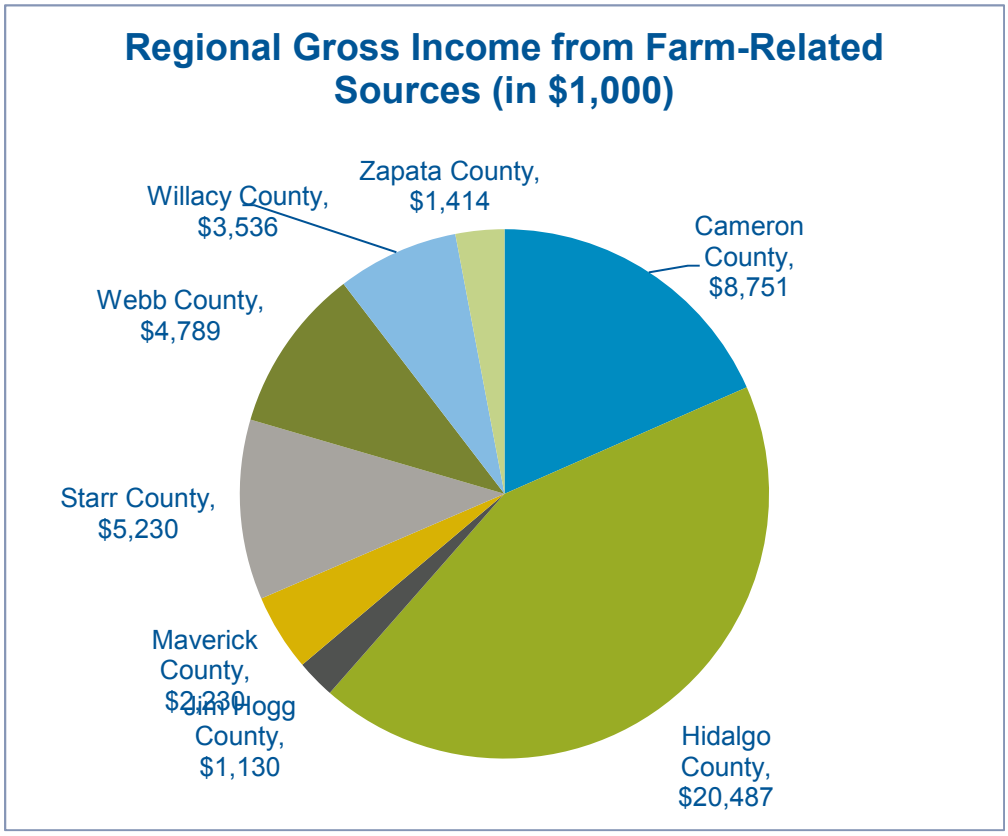

Figure 1-4 Pre-Tax Gross Farm Income by County, USDA 2012 Agriculture Census

Oil and gas production in the region has changed considerably from traditional oil drilling to hydraulic fracturing and nontraditional development, which has a significant impact on the regional economy and associated water demands. Webb and Maverick Counties experienced significant oil and gas activity, and are in the Eagle Ford Shale region. Mining water demands are discussed further in Chapter 2.

Nature tourism contributes considerably to the Rio Grande Valley economy. A 2011 study by Texas A&M University estimated an economic impact of over $344 Million per year in

Cameron, Willacy, Hidalgo, and Starr counties on nature tourism.[3] That comprises a significant portion of the impact of all travel to the region, estimated at $675 Million per year.[4] The quality of the river and its adjacent wildlife habitat will directly affect the number of eco-tourists visiting the region in the future.

In spite of growth in some sectors of the economy, the region as a whole experiences significantly lower income and higher unemployment than the rest of Texas and the nation as a whole (Table 1-2). There is a clear division between the urban growth centers, (Brownsville, McAllen, Harlingen, and Laredo) and smaller rural towns and colonias. Colonias are semi-rural subdivisions that are often built with sub-standard potable water and sanitary sewer systems. The properties are often sold through a contract for deed, which is a loan from the seller to the buyer, paid in installments while the seller retains the title. This arrangement does not allow the homeowner to access traditional home ownership financing. There have been efforts at the state, county, and local levels to provide basic services in many of the colonias in Region M.[5]

Table 1-2 Median Household Income, Poverty, and Unemployment Rate, by County

County	Median Household Income, 2008-2012 ($/year)[6]	Persons Below Poverty Level, 2008-2012 (%)[7]	Unemployment Rate, 2013 (%)[8]
Cameron	$32,558	34.9%	10.1%
Hidalgo	$33,218	35.00%	10.8%
Jim Hogg	$36,919	12.00%	5.4%
Maverick	$30,959	31.20%	12.6%
Starr	$24,653	39.90%	15.4%
Webb	$38,421	30.60%	6.7%
Willacy	$26,369	37.70%	13.8%
Zapata	$28,617	33.40%	6.2%

According to the TWDB, seven out of the eight counties in Region M are labeled as eligible for funds through the Economically Distressed Areas Program.

1.2.3 Surface Water Resources

Region M draws the vast majority of its water from the Rio Grande via the Amistad-Falcon Reservoir system, which is shared with Mexico. The waters of the Middle- and Lower-Rio

[3] An Initial Examination of the Economic Impact of Nature Tourism on the Rio Grande Valley. Report prepared for the South Texas Nature Marketing Coop by: Department of Recreation, Park & Tourism Sciences and Department of Agricultural Economics, Texas A&M University, College Station, TX. September, 2011.
4 The Economic Impact of Travel on Texas, 190-2013p. Prepared for Texas Tourism, Office of the Governor, Texas Economic Development & Tourism, by Dean Runyan and Associates, June 2014.
[5] Texas Secretary of State website, http://www.sos.state.tx.us/border/colonias/faqs.shtml, accessed 2/25/2015
[6] US Census Bureau State & County QuickFacts 8/27/14
http://quickfacts.census.gov/qfd/states/48/48505.html
[7] US Census Bureau State & County QuickFacts 8/27/14
http://quickfacts.census.gov/qfd/states/48/48505.html
[8]Texas Counties: Unemployed Rate, Texas Association of Counties

Grande are managed by the International Boundary Waters Commission (IBWC) and the TCEQ's Rio Grande Watermaster. The majority of the inflows in this section of the river are from the Mexican watershed. Two major treaties between Mexico and the US (1906 and 1944) establish how these waters are shared. Annually, Mexico is to deliver a minimum of 350,000 acre-ft. to the United States on an average over a 5-year cycle. Exceptions are provided for years of extraordinary drought, when the watershed in Mexico cannot provide sufficient runoff water, or in cases of serious accident to hydraulic systems.

Releases from Amistad and Falcon Reservoirs are coordinated to deliver water to users throughout the region. The system of water rights is unique to the Rio Grande and is the result of over a century of varied legal and governance influences. As a result, there is a tiered system that prioritizes Municipal, Domestic, and Industrial (DMI) water rights, and establishes two classes (A and B) of Mining and Irrigation water rights which are fulfilled only in part when supplies are limited. Each tier of water rights has a dedicated 'storage pool' in the reservoir accounting system, and at the end of each month, the DMI pool is replenished to ensure that those water rights can be delivered in full. After this and an operational reserve have been set aside, what remains is available to the Class A and B accounts. In a severe drought, there may not be any water after the DMI and operational reserves are met, and Class A and B rights can be completely curtailed. This impacts not only farmers, but also the functionality of the delivery systems, which rely on irrigation water for the operational baseline flows.

The Arroyo Colorado flows approximately 90 miles from its headwaters southwest of the City of Mission, to its confluence with the Lower Laguna Madre in the northeast portion of Cameron County. The Arroyo Colorado is an ancient distributary channel of the Rio Grande River. The land area that drains into the Arroyo Colorado is known as the Arroyo Colorado Watershed. This area is approximately 706 square miles or 500,000 acres covering portions of three Texas counties (Hidalgo, Cameron, and Willacy), and over twenty-five municipalities in the LRGV. Approximately 330,000 acres of the watershed are used for Agriculture. Agricultural producers in the watershed grow cotton, grain sorghum, corn, sugar cane, citrus and vegetables due to the fertile soil, temperate climate and access to irrigation water. Almost all of the runoff and return flows from these areas are discharged into the Arroyo Colorado and are the main source of excess nutrients entering the waterbody. Perennial (year-round) flow is sustained mainly by flows from municipal wastewater treatment facilities. Irrigation return flows and urban runoff supplement the flow on a seasonal basis.

The Arroyo Colorado River is the primary source of freshwater for the Lower Laguna Madre (LLM) which one of only three hyper-saline lagoons (i.e. saltier than the ocean) in the world and is considered to be the most productive hyper-saline lagoon system. As a result of this, it is imperative that not only adequate amounts of fresh water flow into the LLM, but the water quality meet the needs of the various uses of the water body including irrigation, recreation, industrial, municipal, and aquatic life uses. Having water of good quality improves not only the uses of the Arroyo Colorado, but also improves the economy in the region. The Rio Grande and the Arroyo Colorado are discussed in detail in Chapter 3.

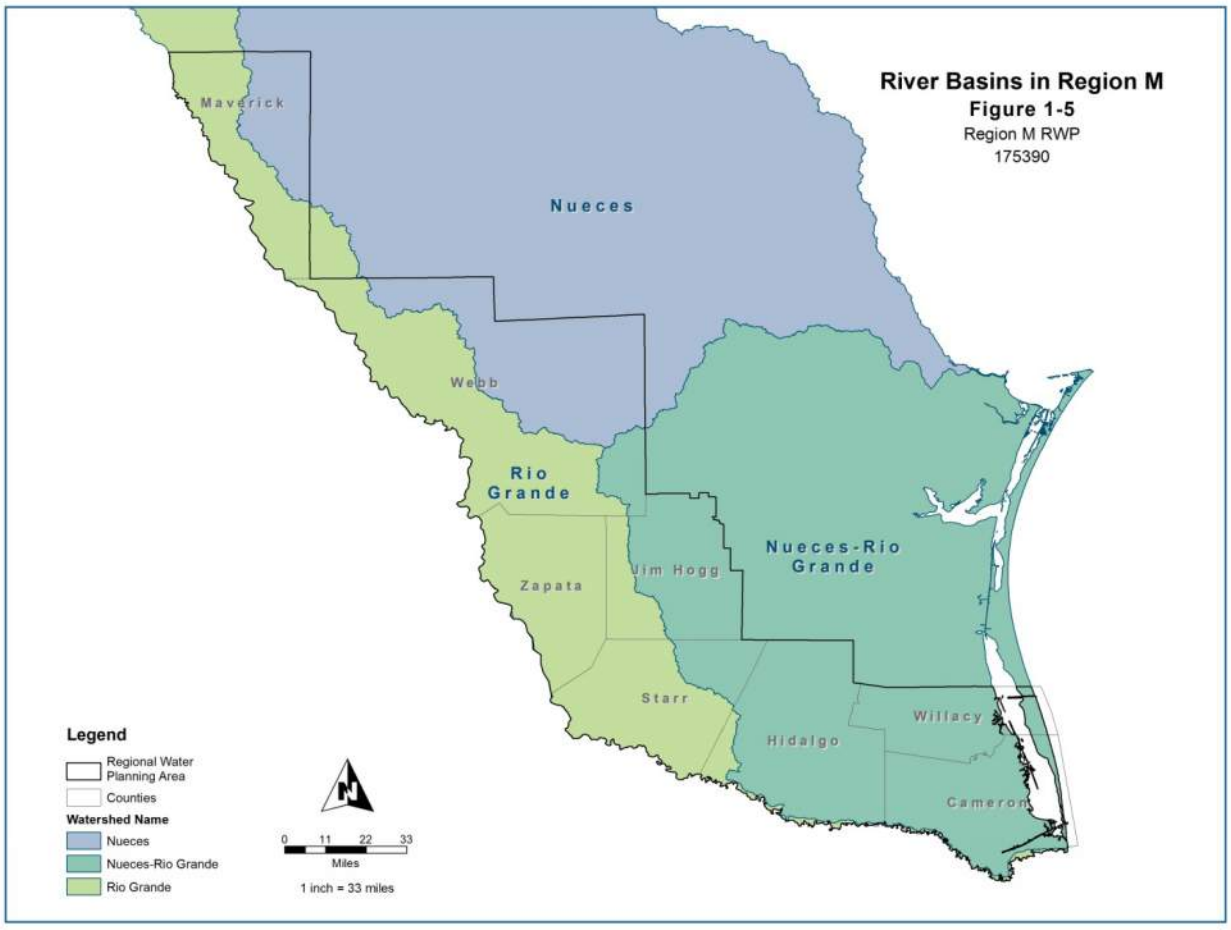

Figure 1-5 River Basins in Region M

The three river basins in Region M are shown in Figure 1-5. The Rio Grande basin in Hidalgo and Cameron Counties is a very narrow strip of land as a result of the river delta. The majority of water that is used in these counties is transported through Irrigation Districts from the Rio Grande basin for use in the Nueces-Rio Grande basin, and these supplies are therefore considered inter-basin transfers.

1.2.4 Surface Water Quality

Surface water quality is addressed in this section for portions of two basins: the Rio Grande, which flows directly into the Gulf of Mexico; and the Arroyo Colorado, which discharges into the Laguna Madre and then into the Gulf of Mexico. In 1991, the Texas Legislature created the Texas Clean Rivers Program (CRP) in order to address water quality concerns in a coordinated manner.[9] CRP conducts water quality monitoring, assessment, and public outreach across the state through partnerships between TCEQ and local agencies. The International Boundary and

[9] International Boundary and Water Commission, US Section Texas Clean Rivers Program. 2015 Basin Highlights Report, Texas Rio Grande Basin Program Update, May 2015. Accessed online: http://www.ibwc.state.gov/CRP/Publications.html

Water Commission (USIBWC) administers the CRP in the Rio Grande Basin, and the Nueces River Authority administers both the Nueces and Nueces-Rio Grande Basins. The programs include regular water sampling, and coordination with other agencies and residents to identify and evaluate water quality issues. The Region M Planning Group has considered the issues identified through the Texas CRP and Clean Water Act, which are discussed below.

The 1972 Federal Water Pollution Control Act, now called the Clean Water Act, is the federal law that establishes the framework for monitoring and control of point-source discharges through National Pollutant Discharge Elimination System (NPDES), requires cities to obtain permits for stormwater or non-point-source discharges, and authorizes federal assistance for public owned treatment works.[10] The Clean Water Act has a national goal of "fishable, swimmable" water bodies, and states are required to identify any waters that do not meet this goal and develop total maximum daily loads (TMDLs) for them. TMDLs are intended to guide watershed management, and are the basis of the monitoring and identification of river segments as impaired that is undertaken in the CRP.

Rio Grande water quality within Region M is evaluated in 4 segments over the Middle Rio Grande Sub-Basin, and three segments in the Lower Rio Grande Sub-Basin. From Amistad Dam south to the confluence with the Rio Salado from Mexico, the river is impaired for contact recreation due to high bacteria below, nitrates and low dissolved oxygen (DO), and concern for toxicity and bacteria near Laredo as a result of urban runoff and discharges outside of U.S. jurisdiction. Manadas Creek, an unclassified water body northwest of Laredo, has high bacteria and chlorophyll-a due to urban runoff and high metal content due to industrial activity. Falcon Reservoir is not impaired, but there is concern for toxicity near Zapata. San Felipe Creek is impaired for bacteria, but has a positive effect on the Rio Grande water quality. The Lower Rio Grande Sub-Basin is separated into the freshwater stream and the stream impacted by tidal flows. The freshwater portion, which runs from Falcon Reservoir to downstream of Brownsville, is impaired in small reaches from consistently high bacteria counts near urban areas. Additionally, there are concerns across the entire segment for fish consumption due to elevated mercury levels. The tidal stream portion has no impairments but there can be high chlorophyll-a levels.

The Arroyo Colorado is the major drainage-way for approximately two dozen cities in this area, and almost 300,000 acres of farmland. The Arroyo Colorado includes the TCEQ Classified Stream Segment 2201 and 2202, which are impaired for high bacteria, and experience high nutrient concentrations. Segment 2201 is also impaired for low DO.

Regular monitoring of water quality as a result of these programs draws attention to the need for continued assessment and evaluation of water data and integrated regional approaches to managing the watersheds to meet quality goals.

1.2.5 Drought of Record

The Drought of Record (DOR) is the basis of the Firm Yield projection for each river basin. The DOR identifies the worst drought on record and the Firm Yield is the supply that can be expected from that river or system in that most severe drought scenario.

[10] USEPA Clean Water Act website: http://www.epa.gov/agriculture/lcwa.html

The Rio Grande Basin and the Amistad-Falcon Reservoir System DOR refers to the drought spanning from February 1993 to October of 2000. This 7.75 year period is the most sever hydrologic drought according to the Rio Grande Water Availability Model (WAM), and is used to predict firm yield over the planning horizon, as shown in Table 1-3.

Table 1-3 Firm Yield Projections, Amistad-Falcon Reservoir System 2020-2070 (Acre-feet/year)

Source	2020	2030	2040	2050	2060	2070
Amistad-Falcon Reservoir System	1,060,616	1,059,260	1,057,903	1,056,547	1,055,191	1,053,834

The current drought of record extends through the year 2000, limited by the extent of naturalized flow data in the WAM. The actual drought extended through approximately 2003, and if the WAM were updated to include those years, may impact the drought of record. Recent years have also seen severe drought in the region, and 2011 and 2012 data could similarly impact the drought of record, and therefore the firm yield projections. It was recommended in the 2011 Regional Water Plan, and is the opinion of the RWPG, that the Rio Grande WAM should be updated regularly. The drought of record is discussed in detail in Chapter 7.

1.2.6 Groundwater Resources

The major aquifer that underlies Region M is the Gulf Coast, which runs the extent of the Texas coast and Hidalgo, Starr, Jim Hogg, and the western portions of Willacy and Cameron Counties. This aquifer is predominantly brackish, with irregular pockets of fresh and very saline water. The Carrizo – Wilcox also spans Texas and extends through Webb and part of Maverick Counties.

The minor aquifers in the region may produce significant quantities of water that supply relatively small areas, including the Rio Grande Alluvium, the Laredo Formation, and the Yegua-Jackson aquifer. Figure 1-6 shows the major and minor aquifers in Region M. A more detailed discussion of each of these groundwater sources is presented in Chapter 3.

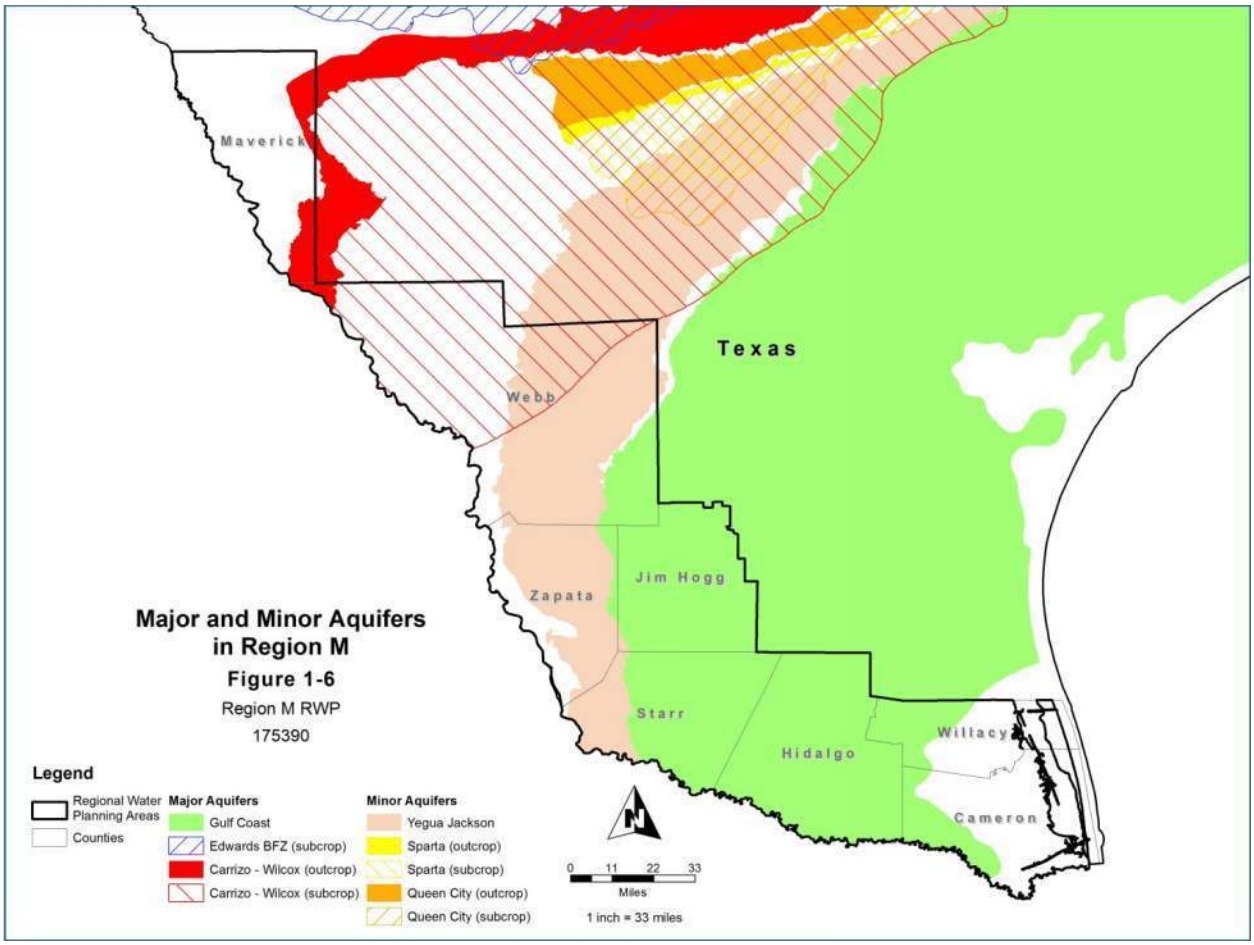

Figure 1-6 Major and Minor Aquifers in Region M

1.2.7 Ground Water Quality

In general, groundwater from the major aquifers in the region has total dissolved solids concentrations exceeding 1,000 mg/L (slightly saline) and often exceeds 3,000 mg/L (moderately saline). There are, however, some areas of fresh and useable groundwater which constitutes a critical supply for many towns, domestic needs in rural areas, as well as livestock. Localized areas of high boron content occur throughout the study area. A recent report from TWDB's Brackish Resource Aquifer Characterization System (BRACS) program presented information on the brackish groundwater resources of the Lower Rio Grande Valley, in response to increased development of these resources. Chapter 3 presents a detailed description of groundwater quality in the Gulf Coast aquifer, Carrizo Wilcox aquifer, Laredo Formation, Rio Grande Alluvium and in other aquifers in the Rio Grande Region.

1.3 Current Water Use

The water user group with the largest demand in Region M is Irrigation, followed by Municipal. Demand in other water user groups is comparatively very small, as shown in Figure 1-7. Regional demand is concentrated in the Lower Rio Grande Valley, specifically Cameron, Hidalgo, Willacy Counties, with a significant municipal demand in the Laredo area of Webb

County. Lower Rio Grande Valley users are primarily served by a network of Irrigation Districts which divert water to farmers and municipal utilities from the Rio Grande.

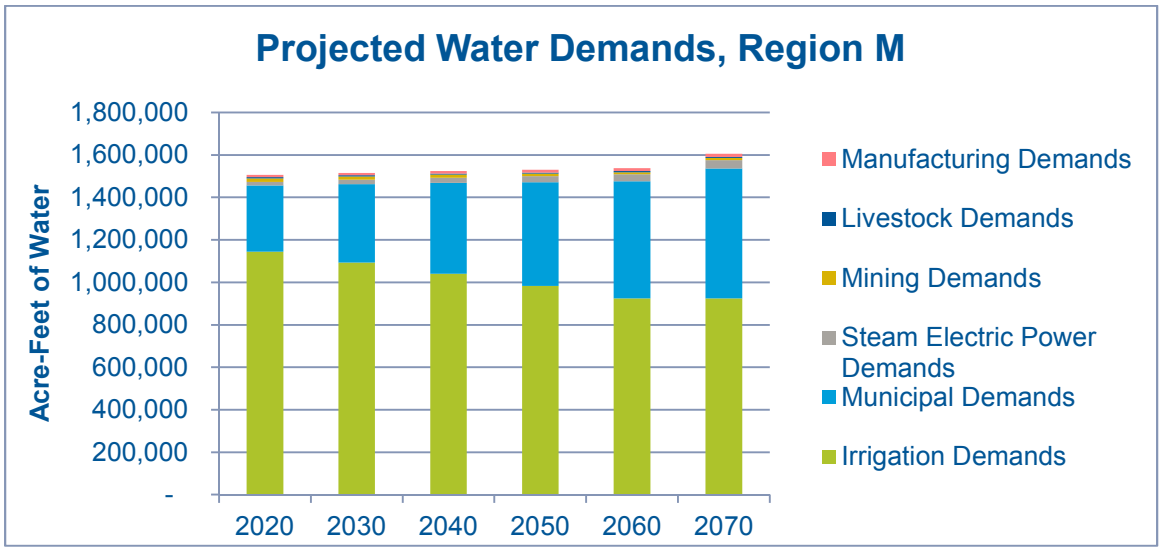

Figure 1-7 Water Demand Projections for Each WUG Type in Region M (Acre-feet/year)

1.3.1 Demands

Municipal demands are expected to increase regionally from a projected 311,591 acre-ft./year in 2020 to 612,127 acre-ft./year in 2070. The majority of this demand is currently met by treated surface water from the Rio Grande, however eight brackish groundwater desalination plants have been built since 2000, supplying a total of approximately 24,000 acre-ft./year of treated potable water. Fresh groundwater availability is limited in the region, and is used mostly as a back-up water supply for utilities or for individual homes, particularly in rural and unincorporated areas, with a few exceptions.[11]

Projected irrigation demands are significantly greater than municipal demands (1.4 million acre-ft./year in 2020 and 0.9 million acre-ft./year in 2070), and are projected to decrease as a result of both urbanization of lands and increasing pressure on the region's water resources. Supplies available to irrigators are curtailed significantly in drought years, because irrigation and mining water rights are treated as residual users of stored water from the reservoirs and therefore bear the brunt of water supply shortages. In essence, irrigation and mining water use must adjust to the available water supply.

The difference between drought year demand and actual use in a particular year for agricultural users can be significant. If a drought year is anticipated, farmers can prepare by planting crops and vegetables with lower water demands, which are often of lower value, but may require fewer or no irrigations. Increases in farming efficiency can also allow irrigators to maintain higher value crops or higher yields in times with less available water. This RWP represents the worst-

[11] Military Highway Water Supply Corporation, and the City of Hidalgo both have significant sources of well water.

case scenario, wherein the demands are based on a dry year, and the measures taken by farmers to prepare for and respond to the drought are considered as Water Management Strategies.

Livestock, Mining, Steam-Electric Power Generation, and Manufacturing demands make up a very small portion of the region's water use as a whole. However, a localized analysis reveals that in some counties mining demands represent a significant portion of water usage (Webb and Zapata Counties), and in Jim Hogg, Livestock demand is over 25% of the county total.

1.3.2 Wholesale Water Providers

Wholesale Water Provider (WWP)--Any person or entity, including river authorities and irrigation districts, that has contracts to sell more than 1,000 acre-ft. of water wholesale in any one year during the five years immediately preceding the adoption of the last regional water plan. The regional water planning groups shall include as wholesale water providers other persons and entities that enter or that the regional water planning group expects or recommends to enter contracts to sell more than 1,000 acre-ft. of water wholesale during the period covered by the plan.

The Texas Administrative Code, Title 31, Rule 357.10

Region M has two general types of Wholesale Water Provider (WWP): those that provide raw water to irrigators, cities, and other types of users, most commonly Irrigation Districts, and those that provide retail and/or wholesale treated water to municipal users and industrial users.

Irrigation Districts[12] divert and deliver raw water to irrigated farmland, and sometimes municipalities, and industrial or livestock users. There are 27 Irrigation Districts in Region M which operate under the Texas Water Code, but each of which has its own internal operating policies. The physical distribution networks are mostly earthen canal, some concrete lined canals, and some pipeline. The water losses within Irrigation Districts, as a result of seepage, evaporation, and operational losses, are as high as 40%. Some districts have worked hard to improve the efficiency of their systems, and others have fallen into disrepair. Irrigation Districts are discussed in more detail in Chapter 3.

[12] For simplicity, the following designations will be referred to collectively as Irrigation Districts in this Plan in reference to their delivery of raw water supplies: Irrigation Districts, Water Control and Improvement Districts, Water Improvement Districts, and other similar designations. Those entities that treat and deliver potable water as well will be noted.

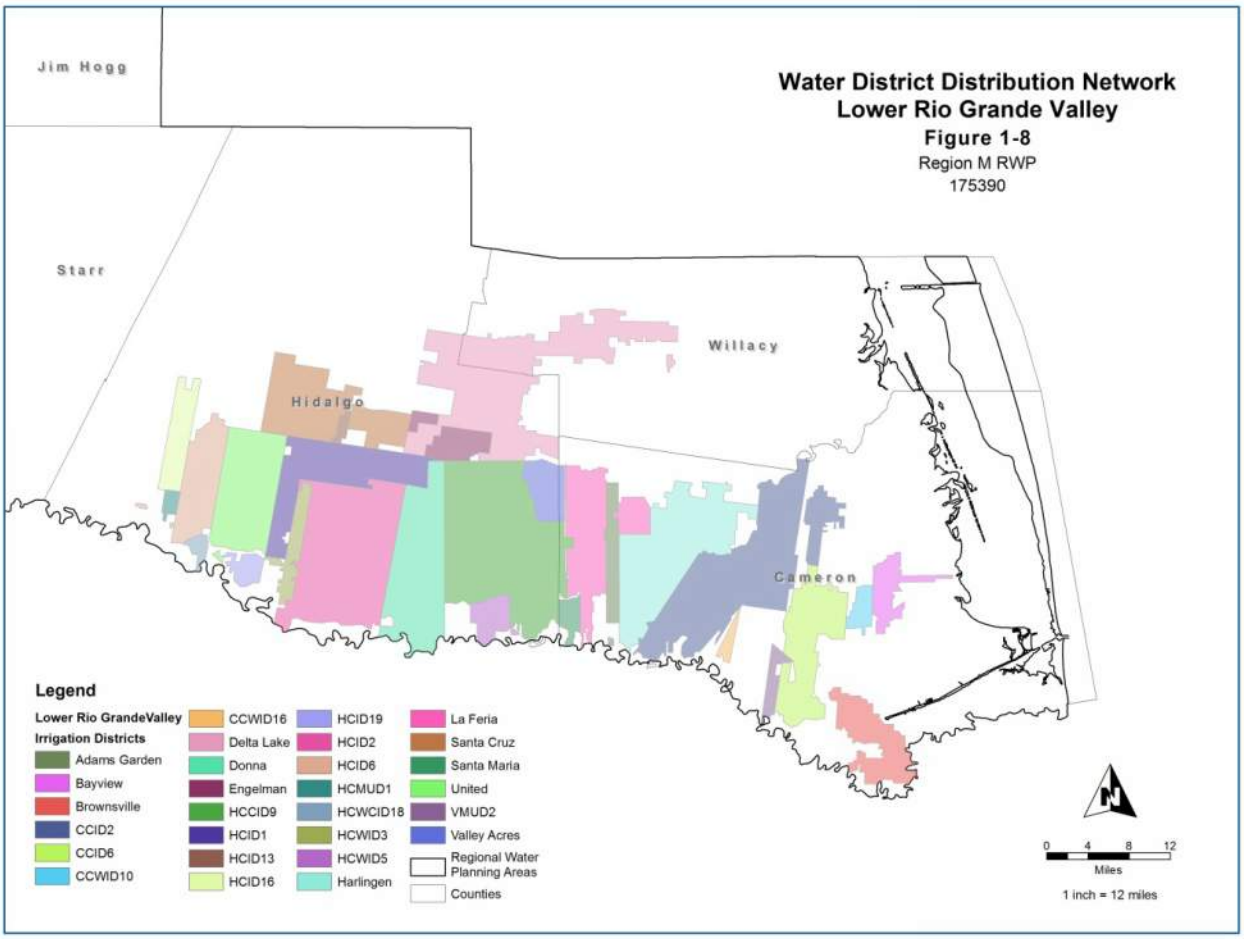

Figure 1-8 Water District Distribution Network, Lower Rio Grande Valley

Water supply corporations (WSCs) cover most of the rural area in the lower Rio Grande Valley, and supply many of the populated rural areas in the western counties. The largest are North Alamo WSC, East Rio Hondo WSC, Sharyland WSC, and Military Highway WSC, which all treat and deliver both surface and groundwater to significant unincorporated and rural areas and portions of cities. Other WSCs in the region include Southmost Regional Water Authority, Valley Municipal Utility District #2, Webb County Water Utility, and Laguna Madre Water District. Brownsville, Eagle Pass, Harlingen, Laredo, Rio Grande City, and Weslaco also sell water to other WUGs in sufficient quantity to be considered WWPs.

The Rio Grande Regional Water Authority has expressed interest in becoming a WWP for the region. The Authority, under a TWDB Regional Facility Planning Grant, is developing the Regional Facility Plan Project, which intends to evaluate preliminary engineering and opinions of probable cost for a regional water supply system or systems. This project is happening concurrently with the 2016 planning process, and is included as a recommended alternative Water Management Strategy (WMS) in Chapter 5.

1.3.3 Agricultural and Natural Resources

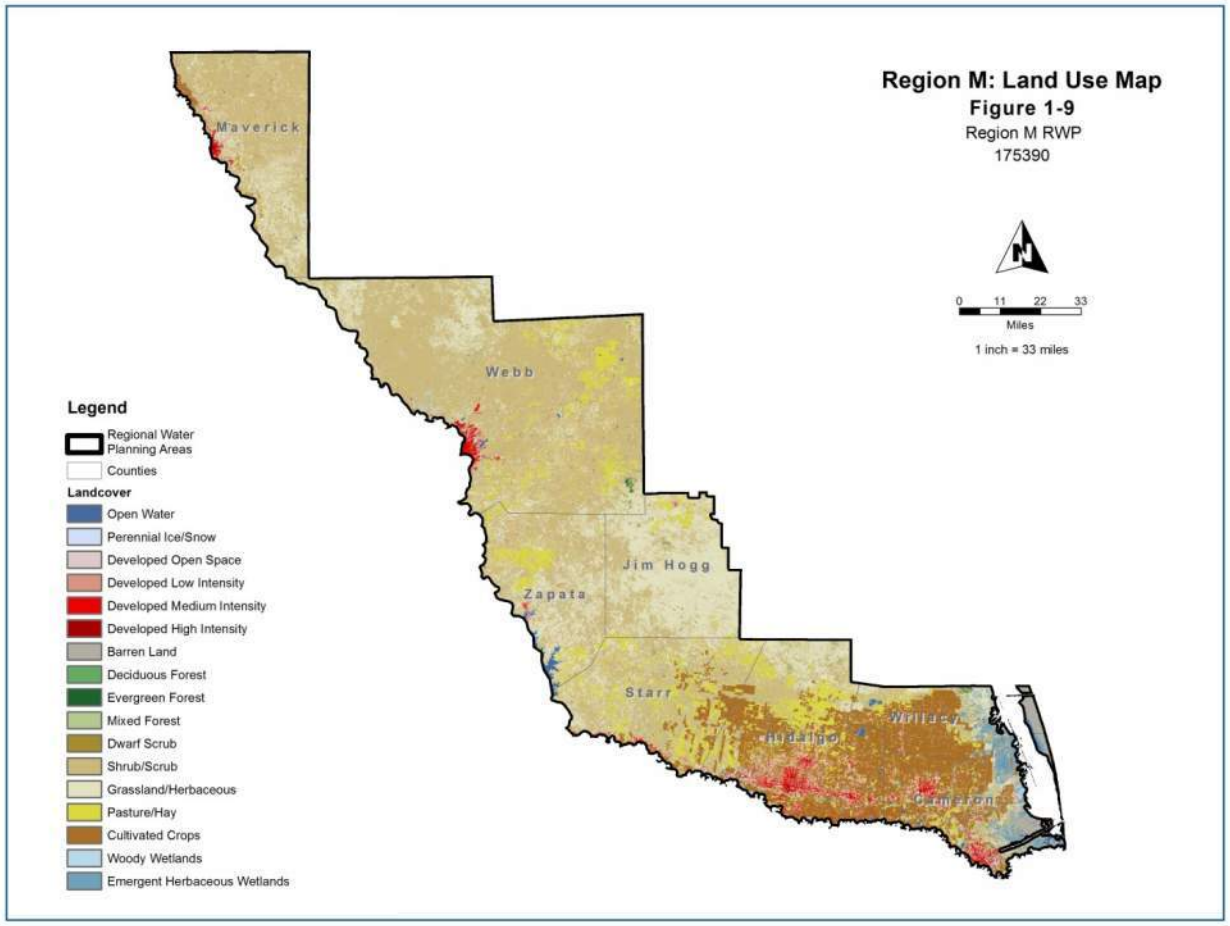

Figure 1-9 Region M Land Use Map

Topography, Geology, and Soils

The Rio Grande Region is located entirely within the Western Gulf Coastal Plains of the United States, an elevated sea bottom with low topographic relief. Topography in the region ranges from a rolling, undulating relief in the northwestern portion becoming progressively flatter near the Gulf Coast. The lower portion of the region consists of a broad, flat plain which rises gently from sea level at the Gulf of Mexico in the east to an elevation of approximately 960 feet in the northern part of Maverick County at the upper end of the region. The western edge of this plain culminates in a westward-facing escarpment known as the Bordas Escarpment. Drainage in the region is by the aforementioned river basins and their tributaries. The Rio Grande River flows southeasterly through the region before turning east to its confluence with the Gulf of Mexico.

Geologic formations exposed in the region include Cretaceous, Tertiary, and Quaternary-aged deposits. In general, the geologic strata of the Rio Grande Region decrease in age from west to east across the area. The oldest strata, which are of Cretaceous age, outcrop in northwestern Maverick County and consist of chalky limestone and marl. The most recent sediments are

located in Cameron County. In general, soils in the Rio Grande Region generally consist of calcareous to neutral clays, clay loams and sandy loams.

Vegetation Areas (Biotic Communities)

Located within the Matamoran district of the Tamaulipan Biotic Province (Blair, 1950), the Lower Rio Grande Valley is the northern boundary of much of the semitropical biota of Mexico. A number of plant and animal species from the more xeric and mesic areas to the west and northeast respectively, converge in the Lower Rio Grande area.

TERRESTRIAL VEGETATIVE TYPES

The predominant vegetation type in this area is thorny brush, but there is overlap with the vegetative communities of the Chihuahuan desert to the west, the Balconian province to the north (Texas Hill Country), and the tropical plant communities of Mexico to the south. The result is unique and varied flora and fauna. Xeric plants such as mesquite (Prosopis glandulosa), leatherstem (Jatropha dioica), lotebrush (Ziziphus obtusifolia), and brasil (Condalia hookeri) are found in this area. Sugar hackberry (Celtis laevigata) and Texas persimmon (Diospyra texana), more prevalent to the north, are also located in the Lower Rio Grande Valley. Other common species such as lantana (Lantana horrida), Mexican olive (Cordia boisierri), and Texas ebony (Pithecellobium ebano) are typically more tropical in location. Montezuma bald cypress (Taxodium mucronatum), Gregg wild buckwheat (Eriogonum greggi), Texas ebony and anacahuita (Mexican olive) have their northernmost extension in the Lower Rio Grande Valley. More than 90 percent of total riparian vegetation and 95 percent of Tamaulipan Thornscrub have been cleared since the 1900s. Surface water remains only briefly in arroyos following substantial rainfall. Because of this scarcity of water the resulting vegetation types are closely correlated to topographic characteristics (LBJSPA, 1976).

Eleven distinct biotic communities compose the Lower Rio Grande Valley, stretching from Falcon Reservoir to the Gulf of Mexico (USFWS, 1997). The communities to the northwest are arid, semi-desert, thorny brush. Vegetation communities toward the coast are comprised of more wetlands, marshes and saline environments (see Figure 1-9).

Ramaderos

This region, which occupies west-central Starr County, consists of arroyos that provide wildlife habitat.

Chihuahuan Thorn Forest

Located below Falcon Dam along the Rio Grande, the Chihuahuan Thorn Forest includes a narrow riparian zone and an upland desert shrub community. Rare plants such as the Montezuma bald cypress and the federally endangered Johnston's frankenia (Frankenia johnstonii) are found here, as well as such uncommon birds as the brown jay (Cyanocorax morio), ringed kingfisher (Ceryle torquata) and red-billed pigeon (Columba flavirostris).

Upper Valley Flood Forest

This community is located along the Rio Grande from south-central Starr County to the western border of Hidalgo County. The floodplain narrows in this region, with typical riverbank trees including Rio Grande ash (Fraxinus berlandieriana), sugar hackberry, black willow (Salix nigra),

cedar elm (Ulmus crassifolia). Only a short distance from the river the dominant species shift to honey mesquite, granjeno (Celtis pallida), and prickly pear (Opuntia lindheimeri).

Barretal

The Barretal community occurs in southeastern Starr County, just north of the Upper Valley Flood Forest. Barreta (Helietta parvifolia), a small tree located on gravelly caliche hilltops, and paloverde (Parkinsonia texana), guajillo (Acacia berlandieri), blackbrush (Acacia rigidula), anacahuita, yucca (Yucca treculeana) and many species of cacti are typical of this community.

Upland Thorn Scrub

Upland Thorn Scrub, the most common community in the Tamaulipan Biotic Province, occurs in southwestern Hidalgo County. Typical woody plants include anacahuita, cenizo (Leucophyllum frutescens), and paloverde.

Mid-Valley Riparian Woodland

This community is located along the Rio Grande from western Hidalgo County eastward to the Sabal Palm Forest. This tall, dense, closed-canopy bottomland hardwood forest is favored by chachalacas (Ortalis vetula) and green jays (Cyanocorax yncas), birds more typical of Mexico. Trees of this community include Rio Grande ash, sugar hackberry, black willow, cedar elm, Texas ebony, and anaqua (Ehretia anacua).

Woodland Potholes and Basins

Central Hidalgo County and western Willacy County contain this community of seasonal wetlands and playa lakes. Additionally, three hypersaline lakes are present, attracting migrating shorebirds. The federally endangered ocelot (Leopardus pardalis) occupies dense thickets in this area. Wetlands are located in low woodlands of honey mesquite, granjeno, prickly pear, lotebush, elbow bush (Forestiera angustifolia) and brasil.

Mid-Delta Thorn Forest

The Mid-Delta Thorn Forest originally covered eastern Hidalgo County, the western two-thirds of Cameron County, and southwest Willacy County. Conversion of land for agricultural and urban uses has left only isolated pockets of native vegetation remaining. Typical plants include honey mesquite, Texas ebony, coma (Bumelia lanuginosa), anacua, granjeno, colima (Zanthoxylum fagara), and other thicket-forming species. This region provides excellent wildlife habitat and is a preferred area for white-winged dove (Zenaida asiatica).

Sabal Palms Forest

This area of riparian forest contains the last remaining acreage of original Sabal Palm Forest in south Texas. It is located on the Rio Grande at the southernmost tip of Texas. Vegetation in this region includes Texas sabal palm (Sabal texana), Texas ebony, tepeguaje (Leucaena pulverulenta), anacua, brasil, and granjeno. The National Audubon Society's Sabal Palm Grove Sanctuary is located in this area.

Loma Tidal Flats

Located at the mouth of the Rio Grande, this community consists of clay dunes, saline flats, marshes, and shallow bays along the Gulf of Mexico. Sea ox-eye (Borrichia frutescens), saltwort (Batis maritima), glasswort (Salicornia sp.), gulf cordgrass (Spartina spartinae), Berlandier's fiddlewood (Citharexylum berlandieri), Texas ebony and yucca are typical plants of this region.

Coastal Brushland Potholes

This community is comprised of dense brushy woodland around freshwater ponds, changing to low brush and grasslands around brackish ponds, and saline estuaries nearer the Gulf of Mexico. Typical plants include honey mesquite, granjeno, barbed-wire cactus (Acanthocereus pentagonus), and gulf cordgrass. Area wetlands provide important habitat for migratory wildlife.

LOWER LAGUNA MADRE

The lower Laguna Madre is a hypersaline bay, in the eastern portions of Cameron and Willacy counties. The Lower Laguna Madre is characterizes by its shallow depth, approximately 2' average, extensive seagrass meadows, and tidal flats. Small portions of the lower Laguna Madre are estuarine in nature with more moderate to brackish salinities. The Arroyo Colorado and Rio Grande provides most of the freshwater inflow to the bay with other drainage canals and floodways having smaller contributions. Freshwater from these sources aid in moderating salinities in the bay and are vital to the success of estuarine dependent aquatic species. The lower Laguna Madre supports a wide variety of marine aquatic organisms and wildlife. It also supports considerable water-related recreational activities (i.e. boating, sport fishing, bird watching, etc.) and commercial fisheries.

Protected Areas

Public and private interests have created several refuges and preserves in the Lower Rio Grande Valley to protect remaining vegetation and the habitats of endangered and threatened species. These include the Lower Rio Grande Valley National Wildlife Corridor/Refuge, Laguna Atascosa National Wildlife Refuge (NWR), Santa Ana NWR, Anzalduas County Park, Falcon State Park (SP), Bentsen-Rio Grande Valley SP, Boca Chica SP, Las Palomas Wildlife Management Area (WMA), Arroyo Colorado WMA, Sabal Palm Audubon Center and Sanctuary, the Nature Conservancy's Chihuahua Woods Preserve, the South Bay Coastal Preserve, Estero Llano Grande, and Resaca de la Palma.

Nine local communities, USFWS, and the Texas Parks and Wildlife Department (TPWD) have recently developed and completed the final stages of the World Birding Center committing $20-25 million to the project. These nine sites are considered world class birding destinations attracting thousands of visitors to view migratory birds and learn about conservation of natural resources.

LOWER RIO GRANDE VALLEY NATIONAL WILDLIFE REFUGE AND WILDLIFE CORRIDOR

The U.S. Fish and Wildlife Service (USFWS), with the support and assistance of the TPWD and several private organizations and individuals, is creating a wildlife corridor along the Rio Grande from Falcon Dam to the Gulf of Mexico. The wildlife refuge serves as the largest component of the Lower Rio Grande Wildlife Corridor. It currently includes 115 individual tracts totaling

91,000 acres. The completed refuge is projected to total 132,500 acres in fee and conservation easements. The wildlife refuges described below are part of this system. Additional acreage is purchased from willing sellers at fair market value or obtained through conservation easements.

LAGUNA ATASCOSA NATIONAL WILDLIFE REFUGE

Laguna Atascosa NWR contains more than 88,378 acres of land, providing essential habitat for a variety of south Texas wildlife. It is located north of the Rio Grande and south of the Arroyo Colorado along the Laguna Madre.

SANTA ANA NATIONAL WILDLIFE REFUGE

This 2,088-acre refuge receives extensive bird watching attention because it is located at the convergence of two major migratory waterfowl flyways, the Central and the Mississippi. More than half of all butterfly species in the U.S. are found in this refuge.

FALCON STATE PARK

This park, managed by the TPWD, contains over 500 acres above Falcon Dam. It is popular with bird watchers because of its diversity of bird species.

SABAL PALM AUDUBON CENTER AND SANCTUARY

This sanctuary, owned by the National Audubon Society, is located in the southernmost point of Texas on the Rio Grande. It is a 527-acre forested area that includes a substantial portion of the remaining sabal palm forest. The sanctuary is popular with bird watchers and other nature enthusiasts for its wildlife. The state threatened southern yellow bat (Lasiurus ega) is a year-round resident. The ocelot and jaguarundi (Herpailurus yagouaroundi) are believed to inhabit parts of the sanctuary.

BENTSEN-RIO GRANDE VALLEY STATE PARK

This park, managed by the TPWD, is located west of Mission in Hidalgo County. It consists of almost 600 acres of subtropical resaca woodlands and brushland, and is a popular bird-watching area. Boca Chica State Park, administered by Bentsen-Rio Grande Valley SP, is located in Southeastern Cameron County. Endangered and rare birds, such as Brown Pelicans, Reddish Egrets, Osprey, Peregrine Falcons, and several others, are commonly found in the park area.

EAST WILDLIFE FOUNDATION RANCHLAND

The East Wildlife Foundation is a nonprofit tax exempt organization, the mission of which is to support wildlife conservation and other public benefits of ranching and private land stewardship. The Foundation includes management of over 215,000 acres of native South Texas rangeland. This land is operated as six separate ranches in parts of Jim Hogg, Starr, Willacy and Kenedy Counties. Traditionally maintained as native rangeland and as working cattle ranches, the lands operated by the Foundation are now managed as a field laboratory for discovery and problem solving.

Rare, Threatened, or Endangered Plant and Animal Species

The federal Endangered Species Act (ESA) of 1973, with amendments, provides a means to conserve endangered and threatened species and the ecosystems on which these species depend.

The ESA provides for conservation programs for endangered and threatened species, and to take steps as may be appropriate for achieving the purposes of conserving species of fish and wildlife protected by international treaty. Federal agencies are required to ensure that no actions that an agency would undertake will jeopardize the continued existence of any endangered or threatened species, except as provided by the ESA. Any federal permits required to implement components of this water plan would be subject to the terms of the ESA.

Within the Rio Grande Region, six plant species designated by the USFWS as rare, threatened, or endangered. An additional 24 species are of great conservation need with no regulatory status. Species designated as threatened or endangered receive full protection under the ESA. Species of need are those species for which there is some information showing evidence of vulnerability, but lacking sufficient data to support listing at the present time.

There are sixteen federally listed threatened or endangered animal species and two species considered candidates for listing with habitat found within the Rio Grande Region that are listed by the USFWS. These include four birds, two fishes, five mammals, and five reptiles. The Texas Parks and Wildlife Department (TPWD) has indicated that an additional 80 species are of great conservation need with no regulatory listing status.[13]

1.3.4 Threats to Agricultural and Natural Resources

As described in detail in Chapter 3, under the existing water rights system, irrigation water use is a "residual" claimant to available water supplies from the Rio Grande. During periods of low inflows to the reservoir system, when there are little or no allocations made to irrigation and mining storage accounts, these users deplete their storage accounts and may suffer shortages.

Under drought of record conditions, hydrologic simulations of reservoir operations indicate that only 60-80 percent of the potential irrigation demand can be satisfied. In essence, the system for the administration of Rio Grande water rights functions as a regional drought management plan in that DMI uses are given a priority over irrigation and mining uses and, during drought conditions, irrigation and mining demands must be reduced to levels that match the available supply. Consequently, irrigated agriculture bears the brunt of drought in terms of supply shortages and the associated economic costs of such shortages.

An additional threat to the availability of water from the Rio Grande for irrigation use is the development and operation of reservoirs on Mexican tributaries. An evaluation of the operation of existing reservoirs during the current drought indicates that significant quantities of water are owed to the United States by Mexico under the terms of the 1944 Treaty. Because of the manner in which available supplies are managed by the State of Texas, any decrease in water availability due to the operation of reservoirs in Mexico will result in further decreases in the available water supply for irrigation and mining use.

An additional threat to the region's water supplies is the drilling and marketing of groundwater in locations which may impact surface water, especially near the Amistad Dam. Water marketing companies are actively seeking water sources to be sold to entities in need of new

[13] Texas Parks and Wildlife Rare, Threatened, and Endangered Species of Texas database, http://tpwd.texas.gov/gis/rtest/ accessed 3/15/2015.

water sources. Recently there has been substantial interest in groundwater in and around Val Verde County. In this particular area, there is strong evidence of interaction between groundwater and surface water, as well as continued study. The pumping of groundwater in the Devils and Pecos river basins have been shown to directly impact these streamflows and the flows in Goodenough Springs, which play a significant role in supplying water for Region M. Any reduction in the water supply in the Amistad Reservoir presents a threat to the whole region, but particularly to irrigators, which would absorb reductions in supply under current reservoir system operation.

Another threat to agricultural and natural resources of the region is the impact of ongoing and projected urbanization on currently undeveloped areas, and the loss of water and habitat availability for wildlife. Increased pumping of groundwater from the Gulf Coast Aquifer and the Rio Grande Alluvium may threaten riparian habitats fringing resacas and potholes. This would have a negative impact on ecotourism. The lowering of Falcon Lake level due to reduced inflow could negatively impact the diversity of bird species that currently exists. WMS in this plan that recommend groundwater use will be limited to the managed available groundwater for each aquifer.

Urbanization plays a major role in determining future demand. The impact can be quantified based on previous rates of urbanization (loss of flat-rate acres and loss of irrigated acres). Particularly in Cameron and Hidalgo counties, projected urbanization is expected to significantly reduce the area of irrigable farmland. Within the Lower Rio Grande Valley, urbanization is expected to be concentrated in corridors along State Highways 77 and 83, with some additional development through agricultural areas. In addition to the direct reduction of irrigable farmland acreage due to change in land use, urbanization also impacts adjacent farmland by increasing property values and restricting some types of agricultural activities (e.g. use of pesticides).

The Irrigation Conservation WMS discussed in this plan aim to assist farmers in making the most of what water is available in drought years. Given the uncertainty associated with irrigation water rights for all of the reasons described above, it will become increasingly critical for farmers to carefully manage their water.

Irrigation Districts play a critical role in the delivery almost 85% of the water used in the Region, including irrigation and municipal water. The improvements discussed in this plan for Irrigation Districts are intended not only to reduce the losses in their systems, but also to allow for better management and controls over their systems, which will enable greater service to farmers and other users.

1.4 Existing Local and Regional Water Plans

1.4.1 Drought Planning

TCEQ requires water conservation plans to be developed, implemented, and submitted by municipal, industrial/mining, and other non-agricultural water right holders of 1,000 acre-ft. of water per year, and agricultural water right holders of 10,000 acre-ft. per year or more. Additionally, all wholesale and retail public water suppliers and irrigation districts are required to develop a drought contingency plan (DCP). Water conservation plans are required to include quantified five and ten year targets for water savings, and DCPs outline entity responses to

drought, including triggers for conservation stages and the restrictions of water use in each drought stage.

Because of these requirements and recent drought conditions, many communities in the Rio Grande Region have addressed drought preparedness and water conservation planning. A review of TCEQ records shows that many communities and Irrigation Districts in the region have water conservation and drought contingency plans.

Table 1-4 lists the entities that have prepared and filed Water Conservation and Drought Contingency Plans as of October 2015. It should be noted that smaller public water systems (i.e., those with fewer than 3,300 connections) were required to prepare drought plans, but do not have to file their drought plans with the TCEQ.

The drought response varies from entity to entity, primarily between those who serve customers, including irrigators, with raw water, and those who deliver treated water. For those entities, like Irrigation Districts, that deliver water to irrigators, the response to drought is focused on the allocation system, and how agricultural water rights are fulfilled when supplies are limited by the TCEQ Watermaster. Each water district responds slightly differently, in some cases allowing water to be sold between farmers in their district, or for a farmer to consolidate their allocation on a portion of their land, leaving other areas for dry land farming.

The entities that deliver treated water generally developed triggers that were either based on the remaining municipal water rights available to the city for that year or the capacities of their treatment plants, such that high demands on the plants trigger a conservation stage. The conservation stages for cities included limitations on car washing and lawn watering, ranging from voluntary in early stages to some fines or other penalties in later stages.

Table 1-4 Local Water Plans Filed with TCEQ

Entity	Water Conservation Plan	Drought Contingency Plan
Adams Garden Irrigation District	✓	✓
Agua Special Utility District	✓	✓
City of Alamo		✓
Brownsville Irrigation District	✓	✓
Brownsville Public Utilities Board	✓	✓
Cameron County Irrigation District No. 2	✓	
Cameron County Irrigation District No. 16		✓
Delta Lake Irrigation District	✓	✓
City of Donna		✓
Eagle Pass Water Works System	✓	✓
East Rio Hondo Water Supply Corporation	✓	✓
Harlingen Irrigation District	✓	✓
Harlingen Waterworks System	✓	✓
Hidalgo Co. Drainage District No. 1	✓	✓
Hidalgo Co. Irrigation District No. 1		✓
Hidalgo Co. Irrigation District No. 16	✓	✓

Entity	Water Conservation Plan	Drought Contingency Plan
Hidalgo Co. Irrigation District No. 2	✓	✓
Hidalgo Co. Irrigation District No. 5	✓	✓
Hidalgo Co. Irrigation District No. 6	✓	✓
Hidalgo Water Improvement District No. 3	✓	✓
La Feria Irrigation District		✓
Laguna Madre Water District	✓	✓
City of Laredo	✓	✓
City of Lyford		✓
Maverick County Water Control and Improvement District No. 1	✓	✓
City of McAllen, McAllen Public Utility	✓	✓
Military Highway Water Supply Corporation	✓	✓
North Alamo Water Supply Corporation	✓	✓
North Cameron Regional Water Supply Corporation		✓
Pharr	✓	✓
Raymondville	✓	✓
City of Rio Grande City		✓
City of Roma	✓	✓
San Benito	✓	✓
San Juan	✓	
San Ygnacio Municipal Utility District		✓
Southmost Regional Water Authority	✓	✓
Union Water Supply Corporation		✓
United Irrigation district	✓	✓
Valley Municipal Utility District No. 2		✓
City of Weslaco	✓	✓
Zapata County Waterworks	✓	✓

1.4.2 Existing Regional Water Plans

Immediately prior to the initiation of the SB 1 regional water planning program, two regional water supply planning projects were conducted within the Rio Grande Region. In February 1998, Phase I of the South Texas Regional Water Supply Plan (STRWSP) was completed under the sponsorship of the South Texas Development Council, with funding assistance from the TWDB. This plan addressed water supply needs in Jim Hogg, Starr, Webb, and Zapata counties. The report for this initial planning phase provided background data and identified key issues that need to be addressed in future water planning. Specific recommendations regarding water supply strategies were not developed.

In February 1999, the Integrated Water Resources Plan (IWRP) for the Lower Rio Grande Valley was completed. This planning effort was sponsored by the Lower Rio Grande Valley Development Council with funding from the TWDB, the U.S. Economic Development

Administration, the U.S. Bureau of Reclamation, and local sources. This plan addressed water planning issues in Cameron, Hidalgo, and Willacy Counties. In addition to comparing projected water supplies and demand, the IWRP makes specific recommendations regarding water supply for the three counties it addressed. One of the key conclusions of the plan is that:

> *"The dramatic population growth will result in an increase in municipal water demands to supply domestic, manufacturing, and steam electric needs. However, these increasing municipal demands, and the remaining agricultural water requirements after the impacts of urbanization are considered, can be met through: improvements to the irrigation canal delivery system; aggressive water conservation efforts in all areas of consumption; and implementation of wastewater reuse, desalination of brackish groundwater and desalination of seawater where cost effective."*

Both the IWRP and the STRWSP were reviewed as a part of this water planning process and serve as valuable references for this regional water plan.

Arroyo Colorado Watershed Protection Plan (WPP) The Arroyo Colorado WPP is a comprehensive watershed-based strategy to improve water quality and aquatic and riparian habitat in the Arroyo Colorado in South Texas. The Arroyo Colorado WPP is in Phase 1 of the WPP process (The implementation period for phase 1 is 2006-2015) but is considered a "living" document subject to revision and modification every 5 years. The Arroyo Colorado Watershed Partnership, which is comprised of stakeholders, has grown to over 720 members. In collaboration with the lower Rio Grande Valley TPDES Storm water Task Force and local citizens, the Arroyo Partnership installed more than 1,000 storm drains that read "No Dumping, Drains to Laguna Madre". Education and outreach activities occur on a daily basis and over 32,000 individuals have experienced the watershed model, a hands-on water quality education tool which demonstrates the impact of pollution within the watershed. Numerous agriculture and wastewater infrastructure BMPs have been implemented.

The Lower Rio Grande Water Quality Initiative has been formed in order to address persistent high bacteria and salinity levels in the Lower Rio Grande. The group is attempting to identify feasible options for the prevention and control of pollution, including a bi-national effort to identify all potential discharges and develop a hydrologic model with recently collected data.

In 2013, the Bureau of Reclamation and the Rio Grande Regional Water Authority evaluated the impacts of climate change on the Lower Rio Grande Valley in a Basin Study, and recommended brackish groundwater desalination as the best alternative water source to ensure reliability in the face of uncertain supplies. The study, funded by a grant through the WaterSMART program, reviewed a range of climate scenarios, and identified a median which resulted in an average of 84,000 acre-ft./year less being available. In response to this reduction, the Basin Study proposed four brackish groundwater desalination facilities and a trunk line to connect three clusters of municipalities, centering around McAllen, Weslaco, and Harlingen. The concept was sized and phased using the Southmost Regional Water Authority model, which was designed to meet 40% of the demands of the member cities. The Basin Study has been used, in conjunction with detailed groundwater data gathered by the TWDB in the BRACS report, to inform other studies, including the Regional Facility Plan Project, currently underway through a Facility Planning Grant from TWDB to the RGRWA.

1.4.3 Public Water Supply Systems

The TWDB conducts water loss audits annually for retail water utilities. The breakdown of all of the aggregated water loss audits from Region M is summarized in Table 1-5 below. The regional percentages of revenue and non-revenue water are very similar to the total revenue and non-revenue water percentages for the entire state: 80.7% and 19.3% respectively. The reported leaks and breaks percentage is slightly higher than the statewide average of 2.2%, and the customer meter accuracy loss is also slightly higher than the 2.7% statewide average.

Table 1-5 Summary of Region M Water Loss Audit Data, 2010 (gallons, %)

<table>
<tr><td rowspan="9">Region M:
37 Audits
Submitted</td><td rowspan="9">System Input
Volume
62,947,376,502</td><td rowspan="5">Authorized
Consumption
51,935,881,430
82.5%</td><td rowspan="2">Billed
Consumption
50,497,957,231
80.2%</td><td>Billed Metered
50,476,734,231
80.2%</td><td rowspan="2">Revenue Water
50,497,957,231
80.2%</td></tr>
<tr><td>Billed
Unmetered
21,223,000
0.0%</td></tr>
<tr><td rowspan="3">Unbilled
Consumption
1,437,924,199
2.3%</td><td>Unbilled
Metered
549,336,235
0.9%</td><td rowspan="7">Non-Revenue
Water
12,449,419,271
19.8%</td></tr>
<tr><td>Unbilled
Unmetered
888,587,964
1.4%</td></tr>
<tr><td rowspan="4">Water Loss
11,011,495,072
17.5%</td><td rowspan="3">Apparent Loss
2,265,061,883
3.6%</td><td>Unauthorized
Consumption
97,702,525
0.2%</td></tr>
<tr><td>Customer Meter
Accuracy Loss
2,137,306,713
3.4%</td></tr>
<tr><td>Systematic Data
Handling
Discrepancy
30,052,645
0.0%</td></tr>
<tr><td rowspan="2">Real Loss
8,746,433,189
13.9%</td><td>Reported Breaks
and Leaks
2,179,358,799
3.5%</td></tr>
<tr><td>Unreported Loss
6,600,194,826
10.5%</td></tr>
</table>