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Chapter 1 – Description of Region

1.1 Regional Water Planning in Texas

In 1997 the State Legislature, through Senate Bill 1, determined that a Texas State Water Plan for the 2000 - 2050 timeframe would be developed through a regional water planning approach. To accomplish this task, the Texas Water Development Board (TWDB) divided the state into 16 regional water planning areas and appointed representational Regional Water Planning Groups (RWPG) that have guided the development of each region's plan. In 2001, a new set of rules and guidelines were enacted through Senate Bill 2. With the help of the Senate Bill 2, the 2002 State Water Plan received enormous public involvement compared to previous plans. The planning process is cyclic, with updated Regional and State Water Plans produced every five years. The 2006 Region H Water Plan and the 2007 State Water Plan were created during the last planning cycle.

1.2 Description of Region H

Region H, located along the upper Texas coast, consists of all or part of 15 counties: Austin, Brazoria, Chambers, Fort Bend, Galveston, Harris, Leon, Liberty, Madison, Montgomery, Polk, San Jacinto, Trinity, Walker and Waller. The eastern portions of Trinity and Polk counties are included in the Region I planning area. The Region spans three river and four coastal basins in southeast Texas. Region H encompasses the San Jacinto River basin, the lower portions of the Trinity and Brazos River Basins, and includes part or all of the Brazos-Colorado, the San Jacinto-Brazos, the Trinity-San Jacinto and the Neches-Trinity coastal basins. This area includes the Galveston and Trinity Bay estuaries, the urbanized, rapidly growing Houston-Galveston Metropolitan Area encompassing Brazoria-Harris-Galveston-Ft. Bend and Montgomery counties, the coastal port communities of Galveston and Freeport, and agricultural areas in Austin, Chambers, Leon, Liberty, Madison, Polk, San Jacinto, Trinity, Walker and Waller counties. *Figure 1-1* is a map of the Region H area. The Region H Water Planning Group (RHWPG) is a 24 member committee representing the diverse interests of the Region. *Table 1-1* lists the RHWPG membership.

Figure 1-1

Region H Water Planning Area

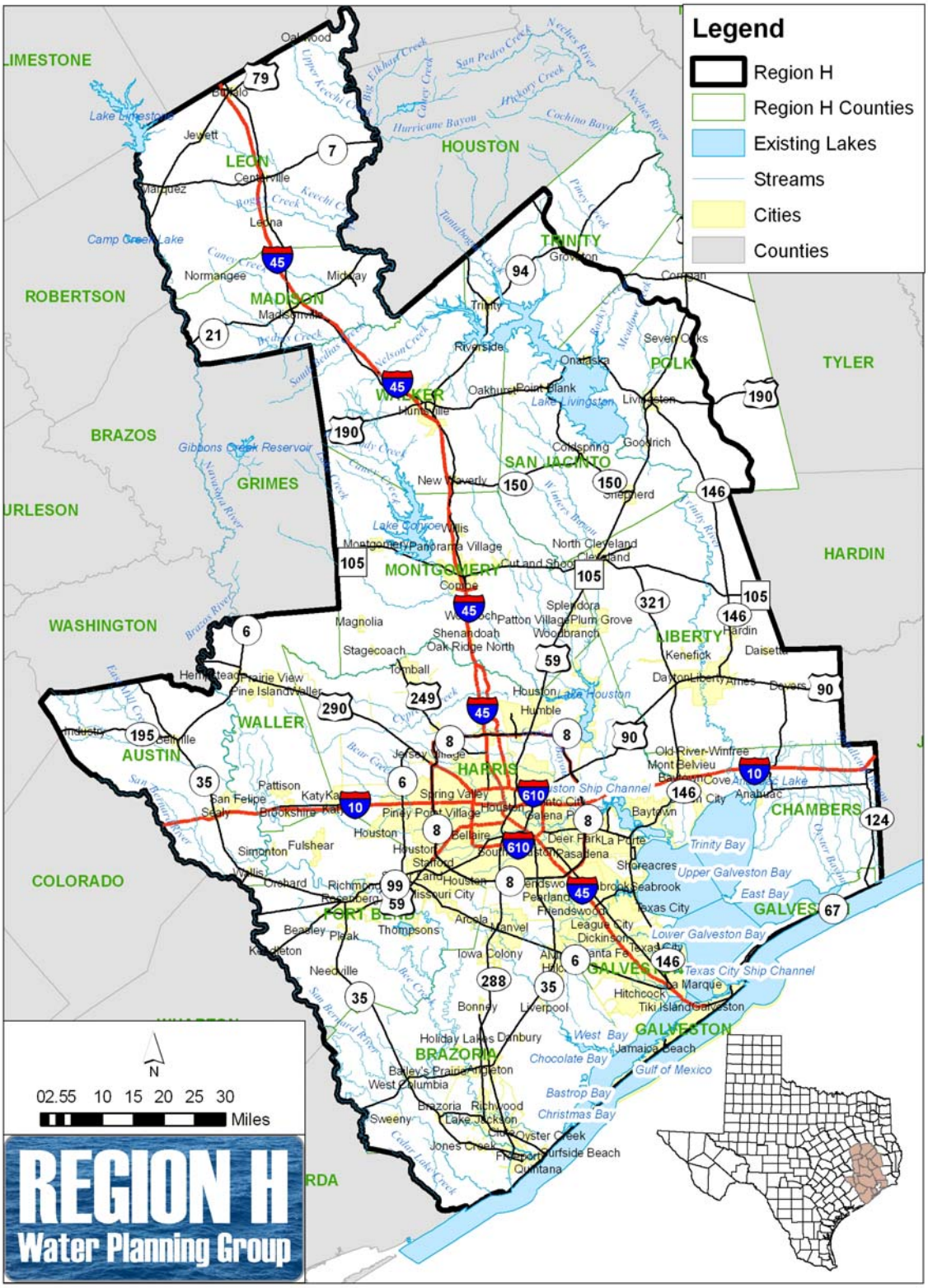


Table 1-1

Member Information for the Region H Water Planning Group

Executive Committee	
Office	**Incumbent**
Chair	Mark Evans
Vice-Chair	Ron J. Neighbors
Secretary	Reed Eichelberger
At-Large	John R. Bartos
At-Large	C. Harold Wallace
Offices	
Office	**Organization**
Administrative	San Jacinto River Authority P.O. Box 329 Conroe, Texas 77305-0329 Phone: (936)-588-1111 Fax: (936) 588-1114
Political Subdivision	San Jacinto River Authority P.O. Box 329 Conroe, Texas 77305-0329 Phone: (936)-588-1111 Fax: (936) 588-1114
NOTES: Administrative Office manages records. Political Subdivision is the entity eligible to apply for State grant funds.	

Table 1-1

(continued)

Voting Membership			
Category	**Member**	**Organization**	**County (Location of Interest)**
Agriculture	Pudge Wilcox Feb 2007 – Present	CLCND	Chambers
	Robert Bruner March 1998 – Present	Rancher	Walker
Counties	John Blount, P.E. Sept 2004 – Present	Harris County	Harris
	Mark Evans March 1998 – Present	Trinity County	Trinity
	Art Henson Nov 2009 – Present	Madison County	Madison
Electric Generating Utilities	Ted Long August 2008 – Present	NRG Energy	Harris
Environmental	John R. Bartos March 1998 – Present	Galveston Bay Foundation	Harris
Industries	Gena Leathers Sept 2009 – Present	Dow Chemical Company	Brazoria
	Glynna Leiper August 2008 – Present	Exxon-Mobil Corp.	Harris
Municipalities	Robert Istre July 2003 – Present	Gulf Coast Water Authority	Galveston
	Jun Chang Nov 2008 – Present	City of Houston	Harris, Fort Bend, Montgomery
Public	Roosevelt Alexander March 1998 – Present	Retired	Waller
River Authorities	Reed Eichelberger March 1998 – Present	San Jacinto River Authority	Montgomery (service in central portion of region)
	John Hoffmann Feb 2009 – Present	Brazos River Authority	McLennan (service in west and southwest portion of region)
	Danny F. Vance March 1998 – Present	Trinity River Authority	Tarrant (service in east and southeast portion of region
Small Business	John Howard May 2007 – Present	Howard Farms	Austin
	Bob Herbert May 2007 - Present	Robert Hebert and Associates	Fort Bend
	Steve Tyler March 1998 – Present	Steve Tyler Creative Solutions	Trinity
Water Districts	Marvin Marcell July 1998 – Present	Fort Bend Subsidence District	Fort Bend
	Ron J. Neighbors March 1998 – Present	Harris-Galveston Subsidence District	Harris, Galveston
	Jimmie Schindewolf Nov 2005 – Present	North Harris County Regional Water Authority	Harris

Table 1-1

(continued)

Voting Membership (continued)			
Water Utilities	C. Harold Wallace March 1998 – Present	West Harris County WSC	Harris
	James Morrison March 1998 – Present	Walker County Rural WSC	Walker
	William Teer, P.E. March 1998 – Present	Retired	Leon

Non-Voting Membership	
Member	**Organization**
David Alders	East Texas Water Planning Group
Rick Gangluff	Lower Colorado Regional Water Planning Group
John Hoffmann	Region G Water Planning Group[1]
Danny Vance	Region C Water Planning Group[1]
Jennifer Bailey	Texas Dept of Agriculture
Temple McKinnon	Texas Water Development Board
Scott Hall	Lower Neches Valley Authority
Rebecca Hensley	Texas Parks & Wildlife Dept
Larry Jacobs	Montgomery County Soil & Water Cons Dist
Wayne Ahrens	West Harris County Regional Water Authority
Melinda Silva	North Fort Bend Water Authority

[1] also a voting member

1.2.1 Governmental Authorities in Region H

While municipal and county governments are the primary governmental entities, there are three regional councils of government represented in the region. The Houston-Galveston Area Council of Governments represents thirteen counties in the central and eastern part of the planning area: Austin, Brazoria, Chambers, Colorado, Fort Bend, Galveston, Harris, Liberty, Matagorda, Montgomery, Wharton, Walker and Waller Counties. The Brazos Valley Council of Governments includes Leon and Madison counties, the two northwestern counties of the region. The Deep East Texas Council of Governments represents Trinity, Polk and San Jacinto counties located in the northeastern part of Region H.

In addition to these regional councils there are several other entities with regulatory or management authority of importance to long range water planning for the region. The State exercises certain responsibilities over water planning, supply and quality through the Texas Water Development Board (TWDB), the Texas Commission on Environmental Quality (TCEQ), and Texas Department of Parks and Wildlife (TPWD). Points of contact for these state agencies are listed in *Table 1-2*. Three river authorities manage surface water supply in the region's three river basins: the Brazos River Authority, the San Jacinto River Authority and the Trinity River Authority. There are eleven soil and water conservation districts within Region H. Five groundwater conservation districts (GCD) in Region H have the authority to regulate groundwater withdrawals. The Harris-Galveston Subsidence District and the Fort Bend Subsidence District have existed for some time. Three new districts were formed in 2001: the Lone Star GCD in Montgomery County, the Bluebonnet GCD, which includes Austin, Grimes and Walker Counties, and the Mid-East Texas GCD which includes Leon, Madison and Freestone Counties. In November 2005, the Brazoria County Groundwater Conservation District was confirmed by voters in Brazoria County,

Two Regional Water Authorities existed in the 2006 Region H Water Plan: the North Harris County Regional Water Authority and the West Harris County Regional Water Authority. Since 2006 two new Regional Water Authorities have been formed: the Central Harris County Regional Water Authority

and the North Fort Bend Water Authority. Municipalities have joined informally to study regional water supply facilities in Mid-Brazoria County.

Table 1-2

State Agencies with Oversight of Water Planning

Texas Water Development Board	
	J. Kevin Ward Executive Administrator PO Box 13231, 1700 N. Congress Ave., Austin, TX 78711-3231 (512) 463-7847
	Carolyn Brittin Deputy Executive Administrator, Office of Planning PO Box 13231, 1700 N. Congress Ave., Austin, TX 78711-3231 (512) 475-0933
Texas Commission on Environmental Quality (plan review)	
	Mark R. Vickery Executive Director 12500 Park 35 Circle, Austin, TX 78753 (512) 239-3900
Texas Parks and Wildlife Department (plan review)	
	Carter Smith Executive Director 4200 Smith School Road, Austin, TX 78744-3291 (512) 389-4800

1.2.2 General Economic Conditions

Two thirds of all U.S. petrochemical production and almost a third of the nation's petroleum industries are located in Region H. The Port of Houston handled 225 million tons in 2007, adding approximately $118 Billion to the state economy. In 2008, the Houston area employed 2.6 million people. Region H is generally characterized with urbanized land uses and broad-based economic development. In areas outside of the urban core, agriculture dominates economic activities. The region supports six primary economic sectors: services, manufacturing, transportation, government, agriculture and fishing.

The service sector employs the greatest number of people in Region H. The most common service industries include: accounting, law, banking, computer software, engineering, healthcare and telecommunications. Medical specialties are concentrated at the Texas Medical Center in Houston and the University of Texas Medical Branch in Galveston. Tourism is also a major industry for both Galveston and Houston. Galveston alone drew more than 6.5 million tourists a year generating approximately $700 million dollars before hurricane Ike in September 2008.

The region's manufacturing industry is based on the historically important energy industries. Petroleum refining and chemical production are the largest two industries in the region. Technology and biotechnology firms have contributed to the diversification of the region's economic base. Petro-chemical, chemical and pulp and paper industries are major employers outside of the urban core of the region.

The transportation industry includes the Port of Houston and the Houston Ship Channel, the second largest port in the nation. A well-developed highway system and rail connections support this activity. The Gulf Intracoastal Waterway connects the ports of Freeport, Galveston, Houston and Texas City.

Government sector jobs are disbursed throughout the region, with the Texas Department of Corrections a major employer at prisons located in the region. The Johnson Space Center has program management responsibility for the International Space Station, ensuring continued economic importance into the next decade. There are numerous colleges in the region, and local school districts continue to grow and expand as population increases.

The agricultural industry, while providing limited numbers of jobs, contributes significantly to the region's economy. Major agricultural crops in the region include rice, soybeans, vegetables and hay. Cattle are the principal livestock, followed by horses and hogs.

Fishing, both commercial and sport, within Galveston Bay and other major bodies of surface water including Lake Conroe, Lake Houston and Lake Livingston are major contributors to the local economic base. One third of the state's commercial fishing income and one half of the state's expenditures for recreation fishing come from Galveston Bay. Oysters, shrimp and finfish are important commercial species in the bay.

1.3 Population and Water Demand in Region H

Based on the 2000 census, the population for Region H was approximately 4,848,948 in the year 2000. Approximately 65% (3,170,496) of this population resides in 98 cities and towns with populations of over 500 persons; 16 of these cities have populations in excess of 25,000. By 2006, the population for Region H had increased to 5,627,524 based on data from the Texas State Data Center as of July 1st, 2006. By 2010 the population in Region H is projected to increase to approximately 6,020,000.

Table 1-3 lists the cities with over 25,000 persons and their 2000 census population, 2006 reported population and associated reported municipal use in 2000 and 2006. The balance of the population resides in smaller communities or the unincorporated portions of the 15 counties of the region.

Table 1-3

Cities with Populations Over 25,000

City	2000 Census Population	2000 Reported Municipal Use (acre-feet/year)	2006 Population[1]	2006 Reported Municipal Use (acre-feet/year)
Baytown	66,430	10,938	70,943	9,866
Conroe	36,811	7,175	51,456	8,070
Deer Park	28,520	4,312	29,944	4,540
Friendswood	29,037	3,968	32,639	4,403
Galveston	57,247	16,228	57,951	-
Houston	1,953,631	347,947	2,112,671	346,393
Huntsville	35,078	5,108	36,999	6,075
La Porte	31,880	4,928	33,823	4,250
Lake Jackson	26,386	3,754	28,449	-
League City	45,444	6,617	63,087	8,491
Missouri City	52,913	10,239	73,748	-
Pasadena	141,674	18,567	152,037	17,716
Pearland	37,640	5,650	67,594	-
Sugar Land	63,328	15,677	84,622	14,883
Texas City	41,521	6,604	43,904	-
The Woodlands	55,649	13,714	-	-

Source: Texas Water Development Board

[1]*2006 Total Population Estimates for Texas counties as of July 1, 2006 from the Texas State Data Center.*

The 2000 and 2006 total county populations and reported 2000 and 2006 water use is listed in *Table 1-4*. Detailed information on local, county and regional population estimates and projections for the 50-year planning period are included in the *Chapter 2* of this plan. In 2006, municipal uses accounted for 48 percent of the region's total reported water use an increase from 41 percent in 2000. In addition to municipal water use, year 2000 estimates of other water use types were prepared by the TWDB for use in the planning process.

Table 1-4

County Population and Municipal Water Demand

County	2000 Census Population	2000 Reported Municipal Use (acre-feet/year)	2006 Population[1]	2006 Reported Municipal Use (acre-feet/year)
Austin	23,590	3,535	26,928	3,741
Brazoria	241,767	40,127	286,773	37,978
Chambers	26,031	3,908	32,383	3,240
Fort Bend	354,452	67,566	487,047	79,802
Galveston	250,158	44,544	282,126	42,931
Harris	3,400,578	598,596	3,830,130	598,977
Leon	15,335	1,880	16,218	2,079
Liberty	70,154	9,350	77,176	6,943
Madison	12,940	1,728	13,534	2,812
Montgomery	298,768	51,193	399,941	62,070
Polk[2]	33,098	4,489	37,295	4,682
San Jacinto	22,246	2,698	24,739	2,540
Trinity[2]	10,380	1,231	10,733	801
Walker	61,758	14,741	64,026	12,340
Waller	32,663	4,610	38,475	5,030
Region H Total	4,848,918	850,196	**5,627,524**	**865,966**

Source: Texas Water Development Board

[1] *2006 Total Population Estimates for Texas counties as of July 1, 2006 from the Texas State Data Center.*

[2] Includes portion of the county in the Region H area

Manufacturing uses accounted for 33 percent of the region's total use in 2006, an increase from 30 percent in 2000. Irrigation uses represented 13 percent of the region's total 2006 reported use, a decline from the 22 percent reported in 2000. *Figure 1-2* illustrates the distribution of 2000 water demand by use type. Total water demands for each county are listed in *Table 1-5*.

Figure 1-2

Percentage of 2006 Total Water Demand by Use

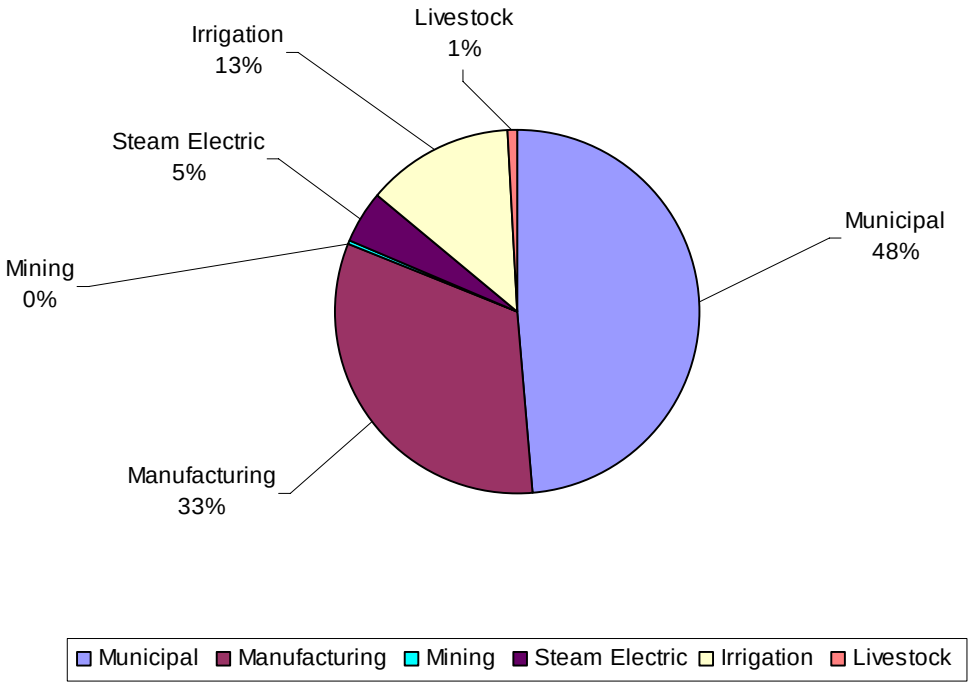


Table 1-5

Reported 2006 Non-municipal Water Use (acre-feet per year)

County	MFR	MIN	POW	IRR	STK	Total
Austin	76	0	0	3,101	1,618	4,795
Brazoria	220,027	374	0	84,820	1,553	306,774
Chambers	13,450	5,281	631	54,594	561	74,517
Fort Bend	4,378	2	70,987	28,703	1,087	105,157
Galveston	18,592	0	158	2,072	255	21,077
Harris	321,469	84	10,076	3,082	1,747	336,458
Leon	799	50	0	242	1,671	2,762
Liberty	384	0	0	40,404	911	41,699
Madison	227	0	0	15	1,112	1,354
Montgomery	1,449	4	729	536	457	3,175
Polk [2]	1	0	0	0	214	215
San Jacinto	11	0	0	0	433	444
Trinity [2]	0	0	0	500	296	796
Walker	63	0	0	400	740	1,203
Waller	27	86	0	17,889	1,253	19,255
Region H Total	**580,953**	**5,881**	**82,581**	**236,358**	**13,908**	**919,681**

Source: Texas Water Development Board

[2] Includes the portion of the county in Region H.

Categories: Manufacturing (MFR), Irrigation (IRR), Mining (MIN), Steam Electric Power (POW) and Livestock (STK)

1.3.1 Major Demand Centers

Major demand centers are locations of water uses that require a significant portion of the region's water supply. As would be expected, major urban areas with large populations and major industrial development are typically major demand centers. In Region H major demand centers are defined for municipal, manufacturing and irrigation uses as having a reported use, by use type, exceeding 25,000 acre-feet for counties and 10,000 acre-feet for cities.

Houston has the greatest overall water demand in the region, as was shown in *Table 1-6,* followed closely by remaining demands in Harris County. The next highest demands are Fort Bend, Montgomery, Galveston, and Brazoria Counties. Harris County and the City of Houston dominate municipal water use in Region H. The City of Houston used 346,393 acre-feet in the year 2006 or approximately 40 percent of the total regional municipal use. As shown in *Table 1-6*, Brazoria, Fort Bend, Galveston and Montgomery Counties are major demand centers with reported use in excess of 25,000 acre-feet in both 2000 and 2006. In addition to the City of Houston, municipalities identified as major demand centers (reported municipal demands in excess of 10,000 acre-feet) include the cities of Pasadena, Galveston, Baytown and Sugar Land.

Table 1-6

Major Municipal Demand Centers

County/City	2000 Municipal Use (acre-feet)	2006 Municipal Use (acre-feet)
City of Houston	347,947	346,393
Harris County (excluding Houston)	250,649	252,584
Fort Bend County	67,566	79,802
Galveston County	44,544	42,931
Montgomery County	51,193	62,070
Brazoria County	40,127	37,978
City of Pasadena	18,567	17,716
City of Galveston	16,228	-[1]
City of Baytown	10,938	9,866
City of Sugar Land	15,677	14,883

Source: Texas Water Development Board

[1] *Not Reported*

The largest manufacturing demand center is Harris County, which used 321,469 acre-feet of water in 2006 (55 percent of the regional total). Two other major demand centers are identified: Brazoria County, with reported 2006 manufacturing use of 220,027 acre-feet, and Galveston County with a reported 2006 manufacturing use of 18,592 acre-feet. The principal water using industries in the region are petroleum refining, chemical products and pulp and paper mills. The three largest manufacturing demand centers are shown in *Table 1-7*.

Table 1-7

Major Manufacturing Demand Centers

County	2000 Manufacturing Use (acre-feet per year)	2006 Manufacturing Use (acre-feet per year)
Brazoria	221,930	220,027
Galveston	35,381	18,592
Harris	349,420	321,469

Source: Texas Water Development Board

The four largest irrigation demand centers are Brazoria, Chambers, Liberty and Fort Bend counties. *Table 1-8* highlights each county's reported 2000 and 2006 irrigation use. The major irrigated crops in the region are rice, soybeans, vegetables and cotton.

Table 1-8

Major Irrigation Demand Centers

County	2000 Irrigation Use (acre-feet per year)	2006 Irrigation Use (acre-feet per year)
Brazoria	149,188	84,820
Chambers	117,777	54,594
Fort Bend	53,455	28,703
Liberty	82,901	40,404

Source: Texas Water Development Board

Livestock and mining water use represent smaller demands in the Region H area. Mining water demands in Region H are associated primarily with oil and gas production.

1.3.2 Water User Group (WUG) Updates

The 2011 Region H Water Plan was updated to include additional Water User Groups (WUGs) based on changes in population estimates. Water User Groups (WUGs) are added when their population increases to 500 or more residents. Three new cities were added to the WUG list based on population estimates for the year 2010. Two recently created regional water authorities-the Central Harris County Regional Water Authority (CHCRWA) and the North Fort Bend Water Authority (NFBWA)-were also added. Descriptions of the new WUGs are presented below.

Kendleton

Kendleton is located in southern Fort Bend County. The 2000 census reported 466 residents in the City of Kendleton; however, the current population according to the Census Bureau is 525. According to the United States Census Bureau, the city has a total land area of 1.1 square miles.

Montgomery

Montgomery is located at the junction of Texas 105 and FM 149, near the southwestern edge of Sam Houston National Forest in western Montgomery County. Its population is approximately 576 residents. According to the United States Census Bureau, the city has a total area of 4.6 square miles which includes 4.5 square miles of land and 0.1 square miles of water.

Stagecoach

Stagecoach is a town in southwestern Montgomery County. The last recorded population for Stagecoach was 507 residents in 2007. According to the United States Census Bureau the city has a total land area of 1.14 square miles and a water area of 0.05 square miles.

Central Harris County Regional Water Authority

The Central Harris County Regional Water Authority (CHCRWA) was created in June 2005 and is comprised of 11 Municipal Utility Districts (MUDs) primarily located north of the City of Houston, east of SH 249, south of FM 1960 and west of I-45.

The CHCRWA absorbed the following WUGs that were stand alone entities in the 2006 Plan: Fallbrook UD, Harris County MUD #150, Harris County MUD #200, Harris County MUD #300 and a portion of the demand in County-Other.

North Fort Bend Water Authority

The North Fort Bend Water Authority (NFBWA) was created by the 79th Texas Legislature in May, 2005.

The NFBWA absorbed the following WUGs that were stand alone entities in the 2006 Plan: Big Oaks MUD, Cinco MUD #2, Cinco MUD #6, Cinco MUD #7, Cinco MUD #8, Cinco MUD #9, Cornerstones MUD, Fort Bend County MUD #2, Fort Bend County MUD #30, Fort Bend County MUD #37, Fort Bend County MUD #41, Grand Lakes MUD #4, Kingsbridge MUD, North Mission Glen MUD and a portion of the demand in County-Other.

1.4 Region H Water Supply Sources and Providers

Groundwater, surface water captured in reservoirs and run-of-river sources comprise the majority of the water supply within Region H. Reused and recycled water and saline sources are additional supply sources utilized in Region H.

1.4.1 Groundwater Sources

Two major aquifers supply groundwater within the Region H area. The aquifer that furnishes the most groundwater within the area is the Gulf Coast aquifer. This aquifer is composed of the Evangeline, Chicot and Jasper formations and extends from near the gulf coast shoreline to approximately 100 to 120 miles inland, to Walker and Trinity counties. The other major aquifer in the study area is the Carrizo-Wilcox, which begins 115 to 125 miles inland and extends beyond the northern boundary of the region. There are also four minor aquifers in this part of the state: the Sparta and Queen City aquifers occur in Leon County, the southern part of Madison County and northern parts of Walker and Trinity Counties. In Leon and Madison Counties, they lie above the Carrizo-Wilcox Aquifer. The Yegua Formation and the Jackson Group comprise the Yegua-Jackson aquifer, located in parts of Madison, Walker, Trinity and Polk Counties. The Brazos River alluvium occurs along the main stem of the Brazos as it passes through the region, except in Brazoria County. *Figure 1-3* and *Figure 1-4* illustrate these groundwater sources. Groundwater use is regulated in Harris, Galveston and Fort Bend Counties due to the potential for over-drafting of the Gulf Coast Aquifer. Groundwater Management Plans have been published for Austin, Leon, Madison Montgomery and Walker Counties. The active Groundwater Conservation and Subsidence Districts within Region H are shown on *Figure 1-5.* Groundwater withdrawals accounted for approximately 34 percent of the total regional water supply in 2000 and approximately 30 percent in 2004.

1.4.2 Surface Water Sources

Surface water sources in Region H are reservoir storage and run-of-river supply for the three rivers in the area: the Trinity, the San Jacinto and the Brazos. There are no major springs located within Region H, although small springs and seeps supply base flows for some streams. Historically there were numerous small seeps identified throughout the region. Many of these have ceased flowing due to land use changes and groundwater pumping. The most significant spring was Cold Springs in San Jacinto County, above the town of Coldspring, with recorded flows of 32 gpm (50 ac-ft/yr) as late as the 1960's.

The following discussion of each basin's surface water supply is based upon information in *Water for Texa*s (1997 and 2002). Water availability estimates come from the TCEQ Water Availability Models (WAMs). *Figure 1-6* illustrates the region's surface water sources. A selected bibliography of related references is included in *Appendix 1A*.

Figure 1-3

Region H Major Groundwater Sources

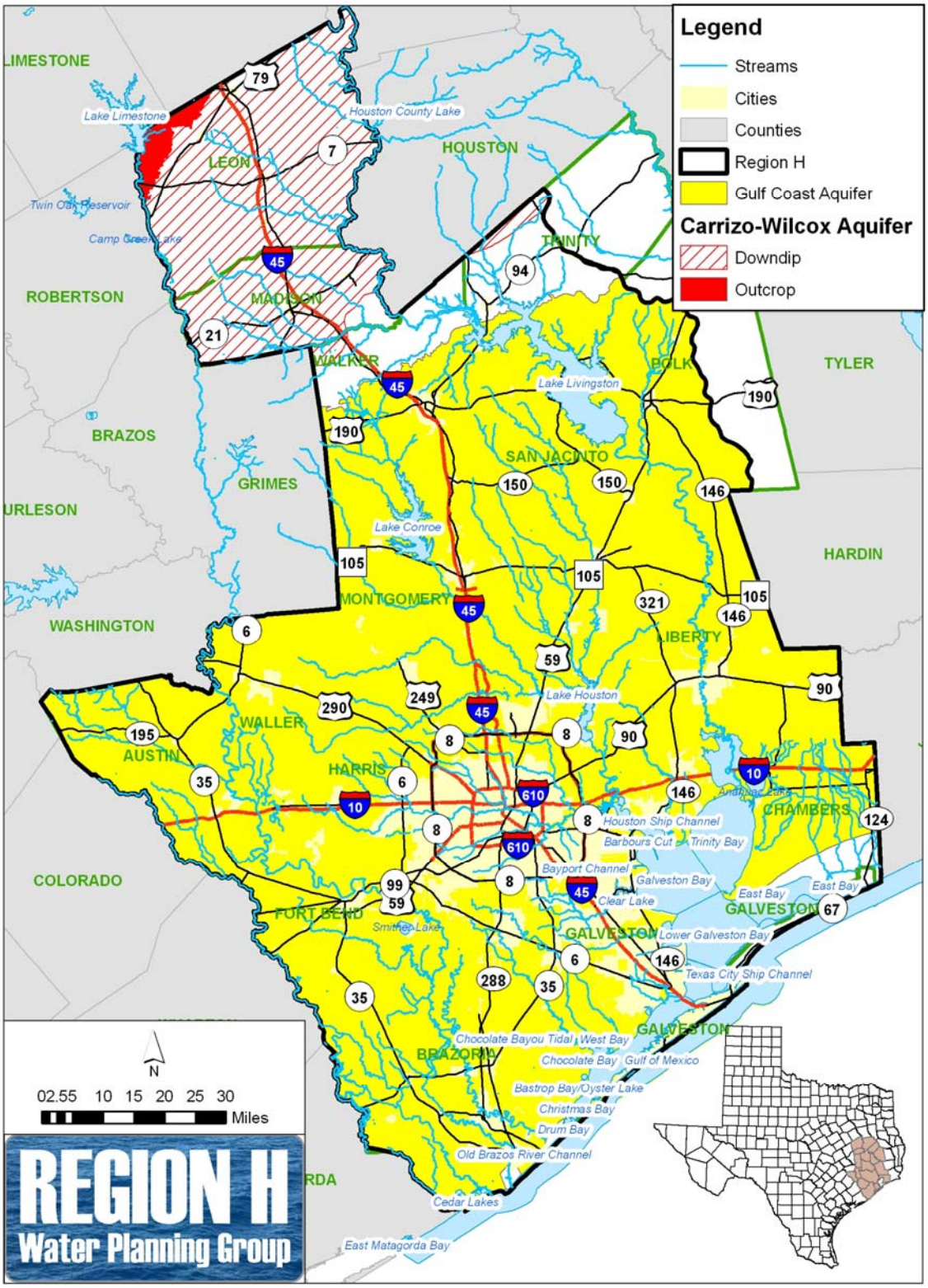


Figure 1-4

Region H Minor Groundwater Sources

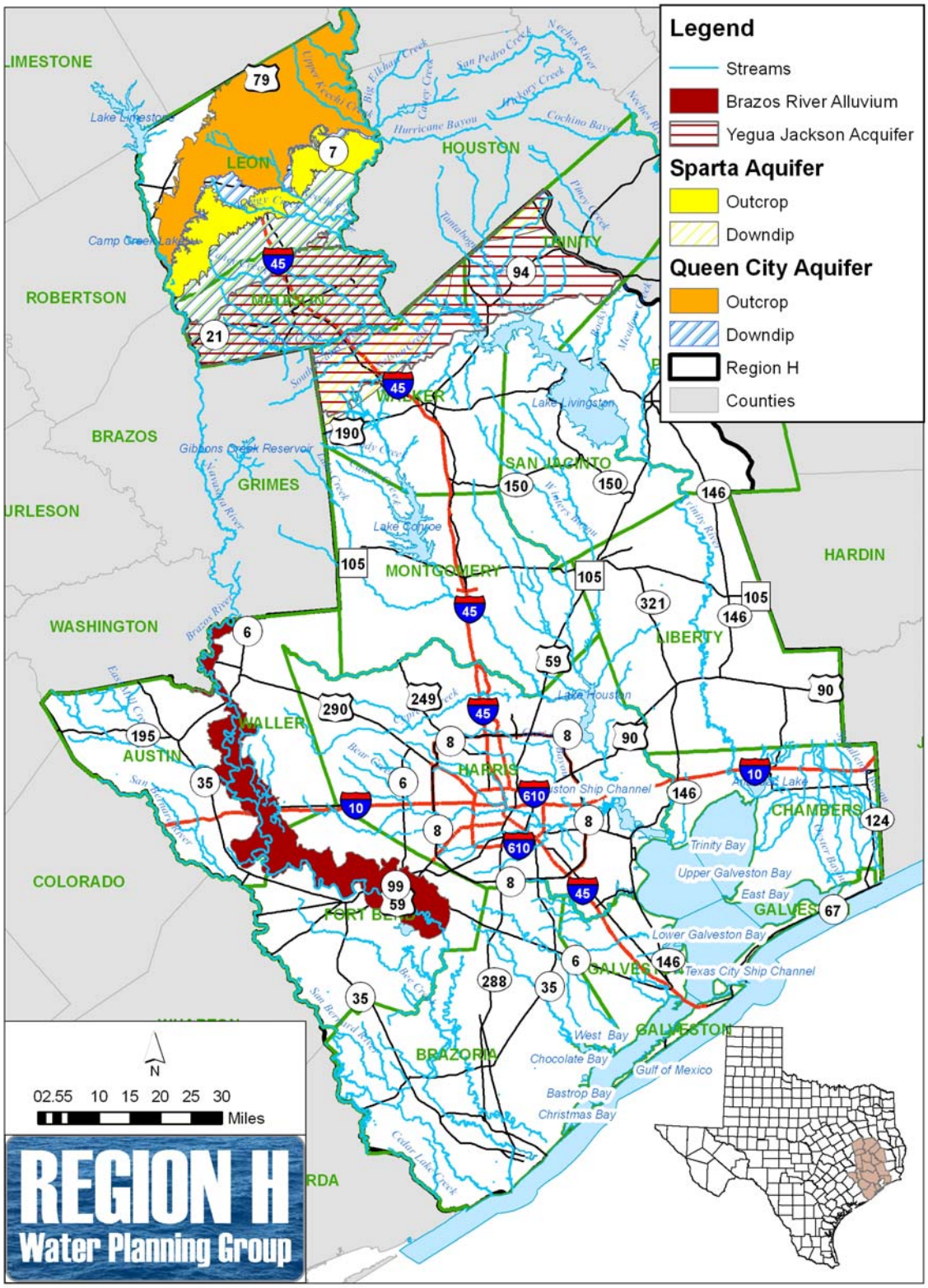


Figure 1-5

Region H Groundwater Conservation and Subsidence Districts

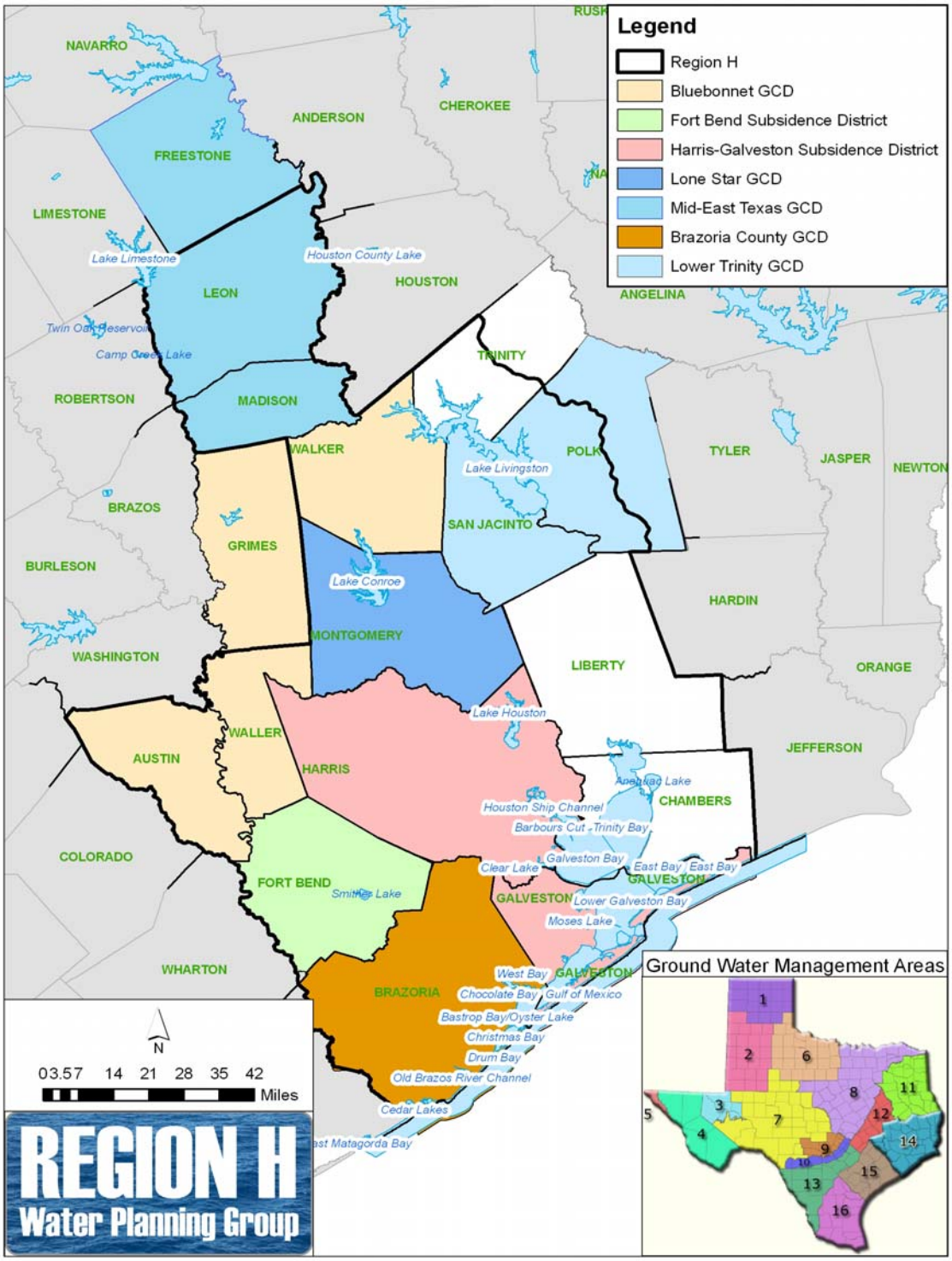
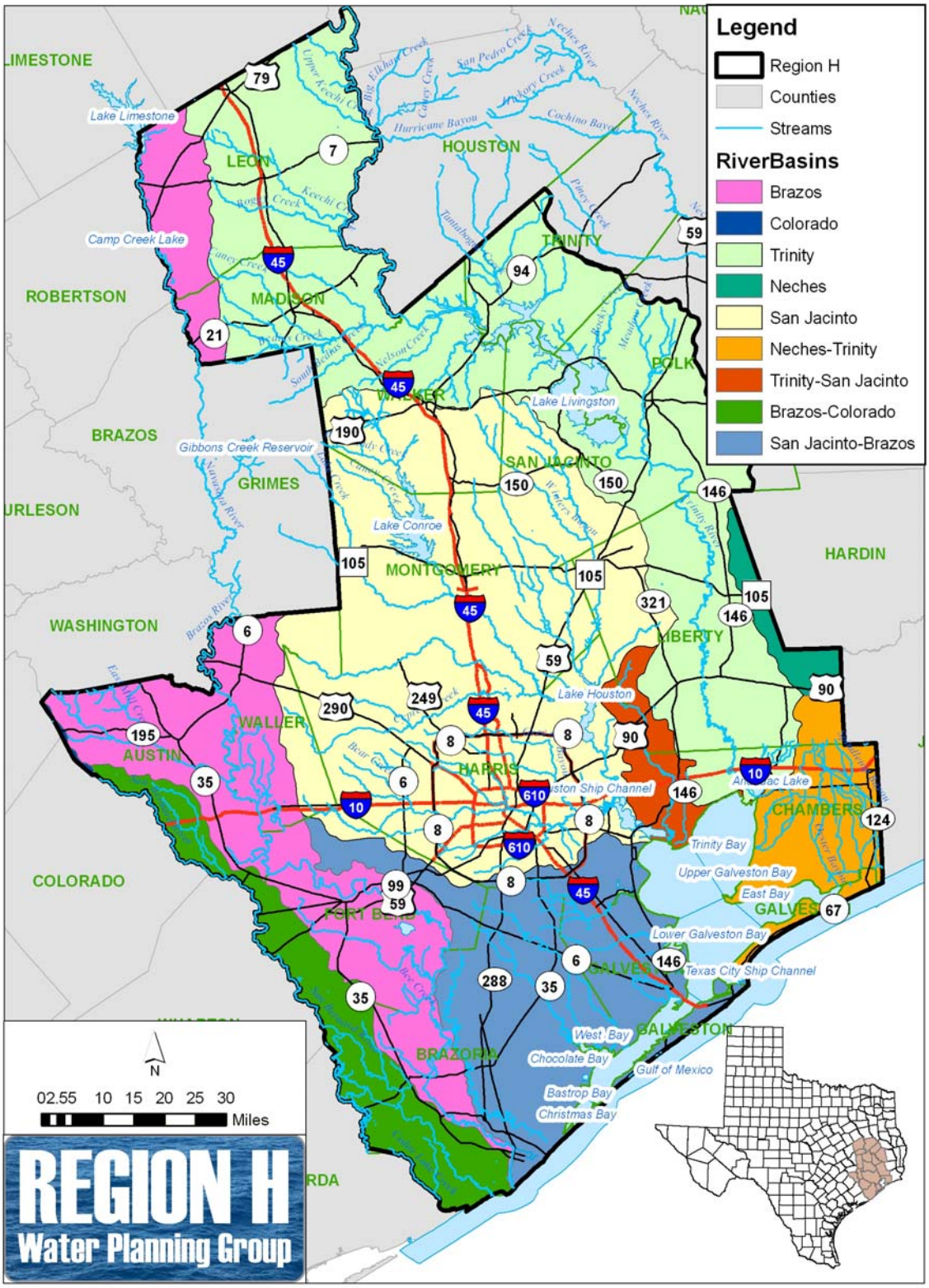


Figure 1-6

Region H Surface Water Sources



1.4.3 Trinity River Basin

The Trinity River basin contains two water projects in Region H: Lake Livingston and the Wallisville Salt Water Barrier. The City of Houston and the Trinity River Authority (TRA) sponsored Lake Livingston's construction. It is operated by the TRA to meet the service demands of the City of Houston and other local users in the Trinity Basin and in the Neches-Trinity Coastal Basin. The U.S. Army Corps of Engineers recently completed the Wallisville Saltwater Barrier. These two projects are operated as a system, using Livingston primarily to store water and Wallisville to control the migration of salt water from Trinity Bay. Lake Livingston and Wallisville permitted yields are 1,255,500 acre-feet/year and 89,700 acre-feet/year respectively. The sum of these permitted yields is the combined yield of the system (1,345,200 acre-feet per year). Additional permitted run-of-the-river water supplies downstream of Lake Livingston total 220,230 acre-feet per year. These supplies are associated with the water rights agreements established at the time of Lake Livingston permitting.

1.4.4 San Jacinto River Basin

The San Jacinto River Basin has two major public water supply reservoirs: Lake Houston and Lake Conroe. Lake Houston, with a permitted yield of 168,000 acre-feet/year, is owned and operated by the City of Houston for use in its service area. The City of Houston and San Jacinto River Authority (SJRA) jointly own Lake Conroe, with the COH holding two-thirds of the permitted rights (66,667 acre-feet/year) and SJRA holding one-third (33,333 acre-feet/year). SJRA manages Lake Conroe, providing supply to Montgomery and Harris County. The SJRA has an additional run-of-river water right of 55,000 acre-feet per year and an indirect reuse water right of 14,944 acre-ft per year that is physically diverted out of Lake Houston.

1.4.5 Brazos River Basin

The Brazos River Authority (BRA) manages the water supply resources from 11 reservoirs within this basin. Several of these reservoirs are operated by BRA as a System Operation where commitments made to downstream demands can be met from any upstream reservoir using storage available in the system. The U.S. Army COE owns eight of these reservoirs, the City of Lubbock owns one reservoir and BRA owns three reservoirs within the basin. In addition to the BRA water supply reservoirs, there are several other reservoirs in the basin. While none of these reservoirs are located within the Region H area, supply from the system is committed in Region H.

The total Brazos Basin supply, including firm supplies from BRA’s reservoirs and reliable yield from run-of-river permits in both Region G and H, is estimated at over 1,200,000 acre-feet per year. The estimated firm yield from BRA's reservoirs is about 650,000 acre-feet per year. Over 500,000 acre-feet per year of the BRA firm supply is committed under contracts to various entities upstream of Region H. Approximately 155,030 acre-feet per year of firm supply is contracted for use in the Region H area. The reliable yield of run-of-river permits granted in Region H is estimated at approximately 418,311 acre-feet per year. Suppliers in the Brazos Basin include Dow Chemical and the Richmond Irrigation Company with permitted diversions of 321,856 and 40,000 acre-feet per year respectively. Each of these entities diverts surface water from the Brazos River and enhances the reliability of their supplies through off-channel surface reservoirs as well as contracts with BRA for upstream supplies.

1.4.6 San Jacinto - Brazos Coastal Basin

There are several significant water users within the San Jacinto-Brazos Coastal Basin supported by the run-of-river water supplies from the Brazos Basin. Suppliers include the Gulf Coast Water Authority which has historically owned two water rights on the Brazos River with permitted diversions of 125,000 and 99,932 acre-feet per year. The GCWA recently purchased former Chocolate Bayou Water Company water rights with permitted diversions of 155,000 and 57,500 acre-feet per year. The estimated reliable yield of all GCWA rights is 229,786 acre-feet per year. The GCWA also enhances

the reliability of their surface water supplies through the use of off-channel surface reservoirs as well as contracts with BRA for upstream supplies.

1.4.7 Use by Source

TWDB reports that Region H used 2,087,514 acre-feet of water in 2000. Of that, 709,990 acre-feet (34%) came from groundwater wells, and 1,377,524 acre-feet (66%) came from rivers and other surface sources. Similarly, the most recent water use estimates of groundwater and surface water use available from the TWDB show that in 2004, groundwater use declined to under 600,000 acre-feet, approximately 30% of the water used in Region H. Surface water use increased to approximately 1,420,000 acre-feet, approximately 70% of the total Region H water use. The three counties with the largest decline in groundwater use were Brazoria, Fort Bend, and Liberty Counties.

Industrial water users (principally chemical industry users) in the region used approximately 1,000,000 acre-feet of saline (sea) water in the year 2000 and the petroleum industry reported the reuse of just over 3,000 acre-feet of treated effluent. *Table 1-9* summarizes the groundwater and surface water usage for each county. *Table 1-10* lists the estimated year 2060 reliable yields available from existing sources to Region H. Further information regarding the yield of major surface water rights in Region H is available in *Chapter 3 – Analysis of Current Water Supplies*.

Table 1-9

County Water Use by Source

County	2000 Groundwater (acre-feet)	2000 Surface Water (acre-feet)	2000 Total Use (acre-feet)	2004 Groundwater (acre-feet)	2004 Surface Water (acre-feet)	2004 Total Use (acre-feet)
Austin	15,928	48	15,976	11,156	1,492	12,648
Brazoria	50,397	365,792	416,189	20,761	357,074	377,835
Chambers	23,005	145,255	168,260	8,085	135,990	144,075
Fort Bend	122,416	70,494	192,910	76,107	76,953	153,060
Galveston	5,001	91,875	96,876	5,880	85,553	91,433
Harris	336,044	637,022	973,066	358,684	673,520	1,032,204
Leon	6,398	0	6,398	4,385	2,443	6,828
Liberty	40,199	61,761	101,960	13,786	69,480	83,266
Madison	2,725	0	2,725	2,611	705	3,316
Montgomery	55,701	576	56,277	54,865	952	55,817
Polk[1]	2,906	1,741	4,647	4,969	2,315	7,284
San Jacinto	3,057	667	3,724	1,955	1,379	3,334
Trinity[1]	1,601	316	1,917	1,000	1,348	2,348
Walker	16,259	1,655	17,914	4,157	10,459	14,616
Waller	28,353	322	28,675	29,551	1,009	30,560
Total	709,990	1,377,524	2,087,514	597,952	1,420,672	2,018,624

Source: TWDB Annual Survey of Ground and Surface Water Use

[1] Includes only the portion of the county in the Region H area

Table 1-10

Projected 2060 Supplies Available for Use in Region H

Groundwater	Projected Yield (acre-feet/year)
Gulf Coast Aquifer	685,843
Carrizo-Wilcox Aquifer	9,610
Queen City Aquifer	7,906
Sparta Aquifer	17,414
Brazos River Alluvium	41,539
Yegua-Jackson Aquifer	6,400
Undifferentiated Aquifer	1,117
Subtotal	**769,829**
Basin/Reservoir/Run-of-River	
Neches Basin	
Sam Rayburn Contract[1]	64,177
Neches-Trinity Coastal Basin	
Run-of-River	21,754
Trinity Basin	
Lake Livingston/Wallisville	1,344,000
Run-of-River, Lower Basin	224,530
Trinity-San Jacinto Coastal Basin	
Run-of-River	34,313
San Jacinto Basin	
Lake Houston	173,000
Lake Conroe	74,300
Run-of-River	55,000
San Jacinto-Brazos Coastal Basin	
Run-of-River	33,051
Brazos River Basin	
Brazos River Authority System[2]	155,031
Run-of-River, Lower Basin	418,311
Brazos-Colorado Coastal Basin	
Run-of-River	12,019
Local Supplies (i.e., stock ponds) all basins	31,895
Subtotal	**2,641,381**
Total	**3,411,210**

[1] Values based on long-term contracts from LNVA to Region H customers
[2] Values based on long-term contracts from BRA to Region H customers

1.4.8 Major Water Providers

A major water provider is an entity that delivers and sells a significant amount of raw or treated water for municipal and/or manufacturing use on a wholesale and/or retail basis. Generally, major providers serve as a primary water sources for a significant portion of the region's municipal or industrial water users and are those entities likely to develop future major water supply projects. As in the rest of the state, Region H has relatively few entities that hold the rights to significant amounts of water, particularly surface water, and provide retail or wholesale water supplies to a significant number of area users.

Five entities in Region H own over 100,000 acre-feet per year of municipal and/or industrial water rights. Their total holdings represent approximately 62 percent of the region's municipal and industrial water rights. The Chambers-Liberty Counties Navigation District (CLCND) has rights of over 100,000 acre-feet per year, but its supplies are currently used primarily for irrigation. Additionally, portions of these supplies are not 100 percent reliable. Reliability is based on modeling diversions under drought of record conditions. Irrigation rights can be issued for supplies that are available on an interruptible basis, i.e. 75-percent of the time. These entities are listed in *Table 1-11* along with other substantial water rights holders.

Table 1-11

Major Region H Water Rights

Provider	Permitted Amount (acre-feet per year)
City of Houston	1,234,567
Gulf Coast Water Authority[1]	449,432
Trinity River Authority [2]	403,200
San Jacinto River Authority	203,377
Brazos River Authority [2]	155,030
Brazosport Water Authority	45,000
Chamber-Liberty County Navigation Dist.	112,947

[1] Includes water right permits purchased from the former Chocolate Bayou Water Co.
[2] Portion currently contracted in Region H only
Source: TCEQ Master Water Rights Database

Four industries hold large manufacturing use water rights to provide for plant operations. These entities, listed in *Table 1-12*, generally do not act as providers to other industrial customers. Dow Chemical, however, provides municipal water supply to the Brazosport Water Authority.

Table 1-12

Large Industrial Water Rights Holders

Industrial Water Rights Holder	Fresh Water Permits (acre-feet per year)
Dow Chemical Company	321,856
Reliant Energy / Texas Genco	166,238
Occidental Chemical Corporation	140,000
Phillips Petroleum Company	39,880

Over 2,300 public water suppliers deliver water to communities and businesses in Region H. A review of these suppliers indicates that 70 percent serve fewer than 500 customers. Of the over 700 municipal providers serving 500 or more customers, over 270 are addressed in this plan as part of collective reporting units. The North Harris County Regional Water Authority accounts for 152 Utility Districts (the two cities in the Authority, Tomball and Jersey Village, are listed separately in the plan). The West Harris County Regional Water Authority accounts for 107 Utility Districts, with its member city (Katy) similarly listed separately. The Central Harris County Regional Water Authority accounts for 11 Municipal Utility Districts. The North Fort Bend Water Authority includes the City of Fulshear, which is listed separately in the plan. A final collective unit in the plan is The Woodlands, a planned community in Montgomery County served by a series of related utility districts.

1.5 Water Quality and Natural Resources

1.5.1 Water Quality

The Texas Commission on Environmental Quality (TCEQ) *2008 Water Quality Inventory* was prepared in compliance with *Sections 305(b)* and *303(d)* of the Federal Clean Water Act. *Figure 1-7* illustrates the impaired stream segments within Region H identified by TCEQ in 2008. The figure was prepared using the 2008 impaired segments GIS data available on the TCEQ website. In addition to water quality data collected by TCEQ, agencies participating in the Texas Clean Rivers Program (CRP) annually compile and publish Regional Water Quality Assessments. In Region H, the Brazos,

San Jacinto and Trinity River Authorities participate in the Texas Clean Rivers Program and have each published reports on the water quality conditions within their respective basins. These reports established the condition of each river and stream segment and identified those segments with water quality concerns for a number of parameters.

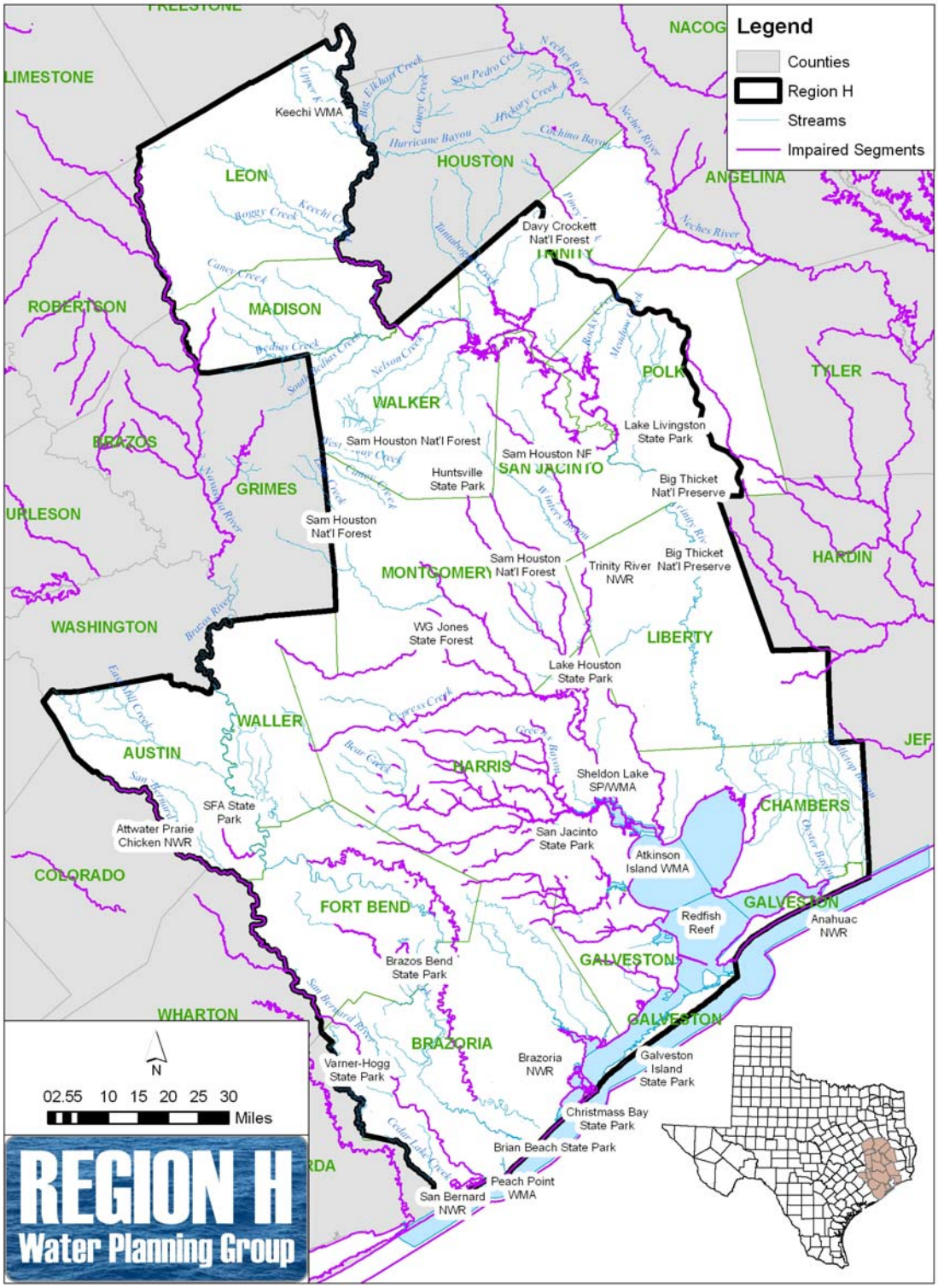
Groundwater within the region is generally of good quality, with total dissolved solids below 1,000 mg/l. Iron is a concern in some portions of the Carrizo-Wilcox Aquifer, and calcium, magnesium and sulfate cause high total hardness in portions of the Brazos River Alluvium. Some groundwater supplies contain arsenic and radon. The current maximum contaminant level (MCL) for arsenic in water used for public supply is 0.01 mg/l set by the Environmental Protection Agency (EPA) in January of 2006. Currently, most groundwater produced within Region H has an arsenic content below the existing MCL. There is a limited area within the northwest part of Harris County where the concentration of arsenic in some sands of the Gulf Coast aquifer exceeds 0.01 mg/l. Wells are now constructed to not screen these sands. In some instances, consideration is being given to treating the water from older wells to lower the arsenic content below 0.01 mg/l. Shallow aquifer contamination has been reported from refinery spills along the Houston ship channel that affects groundwater quality and may affect surface water quality in Galveston Bay.

Radon is not a regulated constituent as a MCL has not been established for it. There are some areas in the west part of Harris County where isolated sands can contain water with higher concentrations of radon. Through geophysical logging to identify these depth intervals and by the use of well construction techniques that isolate the sands, production wells produce water with low levels of radon.

Surface water throughout Region H is of sufficient water quality to be treated for municipal use using conventional measures. Contact recreation use is limited in the lower Trinity River due to fecal coliform bacteria levels. Growth in the San Jacinto River Basin has increased nutrient loading and fecal coliform levels in many streams, particularly Buffalo Bayou. Sand mining, in particular, has lead to increased nutrient loads in the San Jacinto River which can result in an increase in cyanobacteria levels. Likewise, nutrients, dissolved minerals and elevated fecal coliform levels have been identified in the Lower Brazos River. Also of concern in the lower Brazos River are seasonal low flows, which allow the tidal salt-wedge to reach municipal and industrial freshwater intakes in Freeport.

Figure 1-7

Region H Surface Water Quality



1.5.2 Topography

Region H is located in the Gulf Coastal Plains of Texas. It is primarily made up of two vegetational areas: the Gulf Prairies and the Piney Woods.

The Gulf Prairies make up the majority of the region. They hold marsh and saltwater grasses in tidal areas, and bluestems and tall grasses inland. Oaks, elms and other hardwoods grow in limited amounts. The natural grasses make the region ideal for cattle grazing and the fertile soils support rice, cotton, wheat and hay farming. Wildlife in the area includes alligator, river otter, eastern brown pelican, Eskimo curlew, piping plover and whooping crane. Counties in the Gulf Prairie include Austin, Brazoria, Chambers, Fort Bend, Galveston, Harris and Waller.

The Piney Woods encompass the northeastern portion of Region H, consisting of pine forests interspersed with native and improved grasslands. Longleaf, shortleaf and loblolly pine are the dominant native species harvested, but slash pine and various hardwood species are cultivated as well. Timber production and cattle are the principal agricultural products in that portion of the region. Wildlife in the area includes bobcat, ringtail, river otter, red-cockaded woodpecker and bald eagle. Counties in the Piney Woods include Leon, Liberty, Madison, Montgomery, Polk, San Jacinto, Trinity and Walker.

1.5.3 Public Lands

The Region contains 325,394 acres of state and national forests, supporting hiking, camping, picnicking and horseback riding. It also contains 107,138 acres of coastal wildlife refuges for migratory waterfowl, as well as native waterfowl and plant species. It contains a portion of the Big Thicket National Preserve, designated by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as part of the International Biosphere Reserve. Finally, the region holds 12,170 acres of Texas Wildlife Management Areas, preserved for bird watching in coastal areas and seasonal hunting inland. The area names and locations are presented in *Table 1-13*, and a location map is provided at *Figure 1-8*.

Table 1-13

Public Lands

Resource Area	Acreage	County
State and National Forests		
W. Goodrich Jones State Forest	1,725	Montgomery
Davey Crockett National Forest	162,012[1]	Total
	67,329	Trinity
Sam Houston National Forest	161,657	Total
	47,777	Montgomery
	60,247	San Jacinto
	53,633	Walker
State and National Preserve		
Big Thicket National Preserve	86,000	Total
National Wildlife Refuges		
Anahuac NWR	30,000	Chambers
Brazoria NWR	42,338	Brazoria
San Bernard NWR	28,000	Brazoria
Trinity River NWR	6,800	Liberty
Texas Wildlife Management Areas		
Candy Cain Abshier WMA	207	Chambers

Atkinson Island WMA	151	Harris
Keechi Creek	1,500	Leon
Peach Point	10,312	Brazoria

Source: Texas Almanac, Texas Parks & Wildlife Department
[1]Total includes portion of Davey Crockett National Forest located in counties outside of Region H

1.5.4 Navigation

Navigation within Region H rivers is generally limited to the lower reaches of the main stems of the Brazos, San Jacinto, and Trinity Rivers including the Houston Ship Channel and Turning Basin. In addition the Gulf Intracoastal Waterway, an inland canal system that connects ports in the Gulf of Mexico, traverses the Region H coastline through the ports of Galveston and Freeport. There is significant use of rivers, streams and reservoirs throughout the region by recreational boaters and fishermen. There are no navigation water permits in the Region H area.

1.5.5 Threats to Agricultural and Natural Resources

The Regional Water Planning Guidelines (31 TAC 357) require planning groups to "identify threats to agricultural and natural resources of the state due to water quantity problems or water quality problems related to water supply."

There are no water quantity problems for agriculture in Region H. However, it is common practice in the region for irrigators to procure groundwater permits and surface water supplies on a year-to-year basis. The absence of long-term contracts prevents the full representation of irrigation supply as "allocated" in the regional plan. As a result, irrigation is often represented as having a shortage met through water management strategies. The current plan meets all projected irrigation demands. Increased water costs, coupled with decreasing prices for rice and other irrigated crops, may cause agricultural water demand to decline in the future.

Galveston Bay estuary is the most significant natural resource in Region H. The estuary is dependent upon freshwater inflows to maintain seasonal salinity ranges for wildlife habitat and fisheries productivity. The estuary is capable of withstanding natural flood and drought cycles, but the amplified effects of water diversions during a drought may pose a threat to this resource. Target inflow amounts and frequencies for Galveston Bay are discussed in *Chapter 3* and inflows with and without water management strategies are analyzed in *Chapter 4*.

Other natural resources within the region also require minimum in-stream flows. As with Galveston Bay, peak diversions during drought periods may reduce flows to the point that detrimental effects are felt by the environment. Texas is currently developing policies and procedures to determine and protect the required minimum flows in streams and estuaries of the State. In 2007, Senate Bill 3 took effect beginning the environmental flows allocation process. The process began with the creation of the Environmental Flows Advisory Group and the Texas Environmental Flows Science Advisory Committee to guide the statewide process. Two basin and bay area stakeholder groups have been formed to develop recommendations concerning environmental flow regimes, associated policy considerations, and strategies to meet the flow recommendations that will impact environmental flows in Region H. The Trinity and San Jacinto Rivers and Galveston Bay Stakeholders Committee was appointed in July of 2008. The TCEQ is expected to adopt environmental flow standards for the Trinity and San Jacinto Rivers/Galveston Bay by June 1, 2011. The Stakeholder group for the Brazos River/Bay and Estuary Area will be appointed by June 1, 2010 and begin working on recommendations concerning environmental flow regime, associated policy considerations, and strategies to meet the flow recommendations. The TCEQ is expected to approve the group's recommended environmental flow standards by April 1, 2013.

The number of additional threatened and endangered species added to each county by the Texas Department of Parks and Wildlife since the adoption of the 2006 Region H Water Plan is presented in *Table 1-14*. Threatened and endangered species are further discussed in *Chapter 7*.

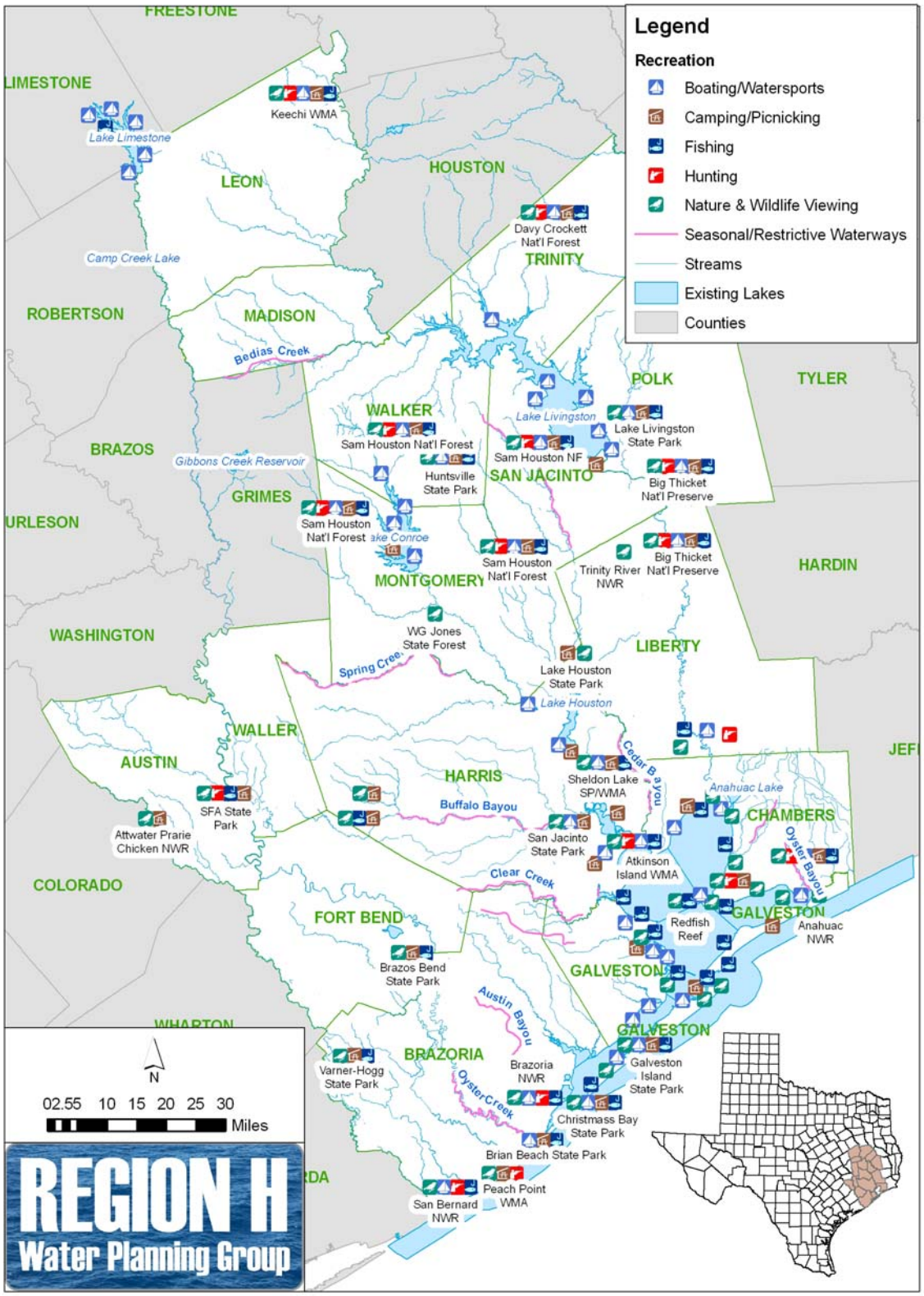
Table 1-14

Threatened and Endangered Species

County	Species (2006 Plan)	New Species	Current County Total
Austin County	4	4	8
Brazoria County	3	13	16
Chambers County	3	13	16
Fort Bend County	3	2	5
Galveston County	4	11	15
Harris County	4	11	15
Leon County	4	4	8
Liberty County	7	5	12
Madison County	3	3	6
Montgomery County	6	4	10
Polk County	6	4	10
San Jacinto County	6	4	10
Trinity County	0	7	7
Walker County	5	4	9
Waller County	5	5	10

Figure 1-8

Public Lands within Region H



1.6 Existing Water Planning

1.6.1 Existing Regional and Local Water Management Plans

The first Region H Water Plan was published in 2001 and was incorporated into the State Water Plan in 2002. The last update to the Region H Water Plan was performed in 2006. The 2006 Region H Water Plan recommended several water management strategies to ensure that all water demands in the Region were met. First, water conservation was recommended for all municipalities with projected shortages. Next, supplies that were identified as surplus in one area were recommended for contract or sale to water users in other areas. These transfers included moving TRA water supply from Lake Livingston to Harris County, moving SJRA supplies from the Trinity Basin to Montgomery County, additional yield from system operation of the BRA system and future reservoir projects. Two new reservoirs were recommended: Allens Creek Reservoir in Austin County to capture peak flows in the Brazos River, and Little River Off-Channel Reservoir in Milam County to supply Region H and the Brazos G Region. In areas with limited groundwater, irrigation conservation was recommended as a means of increasing groundwater for municipal supply.

The Region H area was formerly part of The Trans-Texas Water Program (TTWP): Southeast Area, a comprehensive water resource planning program created to evaluate a full range of water management strategies for a 32 county area of East Texas. This area encompassed all of Region H, plus the lower Sabine River Basin and portions of the middle Brazos River Basin. *The Phase II Report* (1998) identified a regional long-term shortage by the year 2035. To meet that need, several management techniques were studied further: water conservation, wastewater reclamation, use of existing reservoir surplus supply, coordinated reservoir system operation, interbasin transfers and contractual transfers.

Technical studies of these management techniques were completed in Phase II of the TTWP. The *Phase II Report* (1998) determined that the Southeast Area could develop adequate supplies to meet expected regional demands, and export water to Central Texas (Regional Planning Regions L and N). Various management strategies would need to be implemented to accommodate growth in the different geographic areas across the fifty-year planning period. Water conservation, wastewater reclamation and coordinated systems operations strategies would extend the period of adequate supply, allowing additional time to plan and develop new water sources. The Allen's Creek Reservoir in the Brazos River Basin, with an estimated yield at the time of approximately 70,000 acre-feet per year, was reported as a potentially feasible project. Contractual transfers were identified that would align surface water rights with the owner's service areas, shortening conveyance systems. Finally, sustained interbasin transfers from the Toledo Bend Reservoir in the Sabine River Basin to the Trinity and San Jacinto River Basins were also reported as feasible strategies to meet the growing needs of the region and areas of central Texas.

Other previously completed regional water supply plans include the City of Houston Master Plan, Brazos Valley Long-Range Resource Plan, the San Jacinto River Authority Water Resources Development Plan, and the Trinity River Basin Master Plan. Within Region H, the BRA plan also recommended development of the Allen's Creek Reservoir. The SJRA plan recommended development of two reservoirs: Lake Creek and Spring Creek. These projects were put on hold when the SJRA purchased part of the Devers Canal Systems water rights, which allowed the transfer of approximately 50,000 acre-feet per year from the Trinity River Basin. The TRA recommended the development of thirteen potential reservoirs, six of which are located in Region H. The largest, Bedias Reservoir, could provide a formerly estimated 109,000 acre-feet per year, and is located to allow use in the Trinity, San Jacinto or Brazos River Basins.

The Harris-Galveston Subsidence District and Fort Bend Subsidence District developed Groundwater Management Plans to address subsidence through reduced groundwater extraction within their respective regulatory areas. These districts adopted regulatory plans in 1999 and 2003, respectively, setting limits on groundwater use as a percentage of total water demand. Three of the four new

groundwater conservation districts (GCDs) in the region, Bluebonnet, Lone Star and Mid-East Texas GCD, have published groundwater management plans and started the collection of well data needed to consider if a regulatory plan is needed. The Brazoria County Groundwater Conservation District was confirmed by county voters in November 2005.

Additional plans are noted in the Region H Bibliography, included as *Appendix 1A*.

1.6.2 Current Preparations for Drought

The 1997 State Legislature mandated water conservation and drought contingency planning for all holders of municipal, industrial and non-irrigation water rights of 1,000 acre-feet or more and irrigation rights holders of 10,000 or more acre-feet. Previously, all water rights permit applications required a water conservation and drought contingency plan but existing rights holders were not required to prepare or implement plans. New regulations also distinguish between water conservation and drought contingency plans and extend the requirement to prepare and implement drought contingency plans to all holders of water rights as noted above and to public water systems with over 3,300 connections.

In the completed drought plans, the predominant response activities are first a public information effort to alert the public to drought conditions and encourage water conservation. If drought conditions persist, many plans impose mandatory water conservation measures, including restrictions on landscape watering and car washing. Water Conservation and Drought Response are discussed in *Chapter 6* of this report.

1.6.3 Region H Drought Management Study

The Region H Water Planning Group (RHWPG) requested and received funding from the Texas Water Development Board (TWDB) to conduct three studies in advance of the 2011 update of the Region H Water Plan. One study focused on evaluating the impacts of future water management strategies on freshwater inflows to Galveston Bay and on evaluating the impacts of instream flow requirements for future water management strategies. A second study focused on evaluating the feasibility of using available "interruptible" surface water supplies as a substitute for existing firm water supplies for certain uses, notably irrigated agriculture. The third study focused on evaluating the efficacy and impact of drought contingency (a.k.a. drought response) measures as a potential water management strategy in Region H. The key question addressed by this study was:

Can implementation of drought contingency measures within Region H during critical drought periods be used in lieu of other water management strategies to meet projected water demands?

The scope of work for the Region H Drought Management Study was divided into two primary tasks. The first task focused on evaluating the efficacy or effectiveness of drought contingency plans adopted and implemented by municipal water suppliers within Region H, elsewhere in Texas, and nationally. The second task consisted of a quantitative evaluation of the potential impact of drought response measures on major water supply reservoirs in Region H, namely Lake Conroe, Lake Houston, Lake Livingston and the proposed Allens Creek Reservoir. Specifically, Texas Commission on Environmental Quality (TCEQ) water availability models were used to analyze reservoir conditions (i.e., levels and storage volumes) during critical drought periods both with and without implementation of drought response measures.

The study found that most drought contingency plans place a heavy emphasis on "demand management measures" that are designed to reduce water demands by means of curtailment of certain uses. It's important to note that demand management in this context is distinctly different from water conservation, although the terms are often used interchangeably. The objective of water conservation is to achieve lasting, long-term reductions in water use through improved water use efficiency, reduced waste and through reuse and recycling. By contrast, demand curtailment is

focused on temporary reductions in water use in response to temporary and potentially recurring water supply shortages or other water supply emergencies (e.g., equipment failures caused by excessively high peak water demands). Common approaches to water demand curtailment, applied individually or in combination, include:

- Prescriptive restrictions or bans on non-essential water uses and waste. In a municipal setting such restrictions commonly target landscape irrigation, car washing, ornamental fountains, etc.

- Use of water pricing strategies, such as excess use surcharges, to encourage compliance with water use restrictions or to penalize excessive water use.

- Water rationing, where water is allocated to users on some proportionate or pro rata basis.

A significant number of public water systems in Region H were found on the TCEQ drought impact list and implemented drought measures during the years 1998 (62 systems), 2000 (35 systems) and 2005 (39 systems). The counties that recorded the most public water systems on the list are Harris and Montgomery counties. Together, Harris and Montgomery Counties accounted for approximately 55 percent of the systems on the drought impact list. Approximately 90 percent of the water systems on the drought impact list serve populations less than or equal to 10,000 people and have 5,000 or fewer connections. TCEQ records also indicate that the list is comprised mostly of public water systems that are supplied by groundwater.

Surveys of major public water systems indicated that none of the Region H public water systems that were on the TCEQ drought impact list over the period from 1996 to 2008 experienced actual water shortage conditions. Rather, it appears that these water systems were placed on the list because of high seasonal peak water demands and attendant problems or concerns with water production infrastructure. The majority of Region H public water systems on the TCEQ drought impact list are municipal utility districts (MUDs), water supply corporations (WSCs), subdivisions and rural municipalities that rely on groundwater from local wells. Sustained high peak water demands during the summer months often create a strain on groundwater supplies, not so much in terms of the availability of supply but rather in terms of groundwater production capacity, indicating a need for additional wells to increase delivery capacity or deeper wells to compensate for greater than normal drawdown. Public water systems that rely on surface water often experience similar problems in terms of limited capacity to treat raw water and/or distribution system capacity limitations.

The study found that there is very little “good” empirical research to quantify the effectiveness of drought response measures. Most water suppliers that have implemented DCPs have not thoroughly evaluated the effects. “Post-event” analyses was found to typically only report “gross” changes in water demand, most commonly expressed as a percentage reduction. It was also found that most DCPs in Texas are focused on seasonal peaking problems rather than actual water shortage and are always addressed at peak shaving.

The Drought Management Study concluded that, while drought contingency planning is a critical component of water supply management and may provide short-term benefits during severe drought conditions, drought management alone will not replace any recommended long-term water management strategies. The results of the Drought Management Study are discussed in further detail in *Chapter 6* of this report.

1.6.4 Water Loss Audits

An important part of a municipal conservation plan is minimizing the amount of water loss in their distribution system. The 78th Texas Legislature passed House Bill 3338 to provide the TWDB with a mandate to require water loss audits by suppliers. The first water loss audit deadline for submission

to the TWDB was by March 31, 2006. Public utilities will be required to perform water loss audit at least once every five years and provide the data to the TWDB.

The water loss reporting followed a methodology recommended by the International Water Association (IWA) and the American Water Works Association (AWWA) Water Loss Control Committee. The methodology relies on defined water use categories as shown below:

Water Losses:

- Apparent Losses represent water that was used but not paid for, resulting in lost revenue. Apparent Losses include:
  - Unauthorized Consumption
  - Customer Meter Under-registering
  - Billing Adjustment and Waivers
- Real Losses represent water that is physically lost from the water system prior to use, resulting in lost revenue. Real Losses include:
  - Main Breaks and Leaks
  - Storage Overflows
  - Customer Service Line Breaks and Leaks

The study results found a high level of inaccuracy, particularly in Regions B, H and M suggesting that utilities in the regions should refine their water accounting procedures. Within Region H, the study utilized information provided by 638 utilities. The utilities ranged in type and were categorized as City, MUDs, SUDs, WCIDs, WSCs or Other. The number of utilities in each category along with the estimated total Apparent Loss, Real Loss, and Total Losses are presented in *Table 1-15*. The Total annual value of the reported water loss in Region H ranged from a lower bound value of approximately $33,800,000 to an upper bound value of $128,200,000. The large discrepancy between lower and upper bound estimates is the result of inaccuracies in the water loss estimates.

Table 1-15

Water Loss by Type (acre-feet per year)

Utility Type	Number	Total Apparent Loss		Total Real Loss		Total Loss	
		Min	Max	Min	Max	Min	Max
City	49	0.0	4669.4	0.0	3182.4	0.0	4750.5
MUD	281	-5.3	185.8	0.0	165.5	-4.7	251.5
SUD	36	0.0	227.3	0.0	96.1	0.0	182.3
WCID	24	0.0	865.9	0.0	302.2	0.0	1168.1
WSC	147	-0.2	116.3	0.0	55.6	-0.2	135.1
Other	101	0.0	865.9	0.0	314.8	0.0	1168.1
Total	638	0.0	0.0	0.0	0.0	0.0	0.0

The study made the following recommendations for utilities and the Regional Water Planning Process:

- Utilities should implement annual or biennial programs to gradually reduce the uncertainty in their water audits. The programs should target water audit categories with the most uncertain water volume estimates.

- Regional Water Planning Groups should use the research results to estimate the potential water savings from water system audits and loss prevention strategies and should update the regional water plans accordingly.

- The TWDB should work to align the regional water planning cycle and the water audit reporting cycle so that up-to-date water loss data is used in developing the regional water plans.

1.7 Recommendations Made in the 2006 Region H Water Plan

In the 2006 Region H Water Plan, the RHWPG recommended twenty-two water management strategies to meet projected water demands through the year 2060. The planning group recommended eight stream segments and four reservoir sites as unique, and also recommended regulatory, administrative and legislative changes to the Legislature. Those recommendations are listed below.

1.7.1 Water Management Strategies Recommended in the 2006 Regional Plan

The RHWPG considered a variety of strategies for meeting the projected shortages and solicited input from the public before adopting a management plan. A detailed analysis process was developed to define potential water management strategies. The process addressed the specific shortages of 193 WUGs and then developed associated specific strategies assuming Major Water Providers would be the vehicle to solve WUG shortages. The process generally consisted of the following:

Municipal Conservation – For WUGs with projected shortages, an appropriate level of water conservation would be implemented, as discussed below.

Contract Extension and Increase – For all WUGs currently served by a wholesale water provider (WWP), it was assumed that current contracts would be renewed throughout the planning period. Additionally, it was assumed that WUGs would increase their contracts with their current WWPs to meet projected growth, until current WWP supplies were fully allocated. This could not be applied to collective WUGs, such as Manufacturing.

This met the supply needs for 15 of the 193 WUGs with shortages. The remainder of the WUGs with shortages were grouped and addressed by county. Potential water management strategies were screened and considered to meet the needs of each county. The strategies considered included those in the 2001 Regional Water Plan, new water rights applications, wastewater reuse and seawater desalination. The consideration of new supply sources allowed the RHWPG to replace two reservoir projects recommended in the 2001 Plan. Management strategies that involved adjoining regions were coordinated with the appropriate water planning group.

The water management strategies selected in the 2006 Region H Water Plan to meet the projected growth were as follows:

Municipal Conservation—The conservation strategy was applied at the WUG level, reducing demands from 5.5% to 7.0%, depending on the size of the WUG. Projected water savings totaled 71,109 ac-ft/yr in year 2030 and 101,200 ac-ft/yr in year 2060.

Industrial Conservation—Industries with projected shortages will seek out ways to reduce their water demand as a means of managing their operating costs. The wide range of industries within Region H, and their varying progress in this area, prevented the estimation of projected savings for this strategy.

Irrigation Conservation—Reduction of on-farm demands through land leveling, canal lining and other system improvements. Projected water savings were 18,792 ac-ft/yr in Brazoria County, 24,018 a-ft/yr in Chamber County, 5,198 ac-ft/yr in Fort Bend County, 2,392 ac-ft/yr in Galveston County, 20,877 ac-ft/yr in San Jacinto County and 6,606 ac-ft/yr in Waller County.

Expanded Use of Groundwater—Only a portion of the groundwater available to Region H is developed supply (i.e., existing wells). An additional 91,500 ac-ft/yr of new well capacity was needed to fully utilize this resource.

New Contracts for Existing Supply— WWPs with unallocated existing supplies were identified, and new contracts were recommended within existing service areas.

Luce Bayou Transfer—This conveyance project enables the City of Houston to transfer water it owns in the Trinity basin to Lake Houston to meet projected growth in north and northwest Harris County.

Brazos River Authority System Operations—The Brazos River Authority has applied for a water right that permits existing additional yield within their reservoirs, and new yield that can be achieved through operation of their reservoirs as a basin-wide system. Approximately 120,000 ac-ft/yr of this water was estimated to be available for customers in Region H in the 2006 plan..

Allen's Creek Reservoir—This proposed reservoir creates 99,650 ac-ft/yr of supplies for the City of Houston and the Brazos River Authority.

Little River Off-Channel Reservoir—This proposed reservoir creates 32,100 ac-ft/yr for the Brazos River Authority.

Non-Municipal Contractual Transfer—This strategy involved the transfer of 21,000 ac-ft/yr of manufacturing, mining and irrigation supplies from WUGs with surpluses to WUGs with needs in Brazoria and Galveston Counties.

Wastewater Reclamation for Industry—This strategy proposed that 67,200 ac-ft/yr of Houston's municipal wastewater be treated and directly reused by industries along the Houston Ship Channel.

Houston/Trinity River Authority Contract—Under this strategy, the City of Houston would purchase up to 150,000 ac-ft/yr of uncommitted supplies from the Trinity River Authority.

SJRA/Trinity River Authority Contract— Under this strategy, the SJRA would purchase up to 50,000 ac-ft/yr of uncommitted supplies from the Trinity River Authority to serve Montgomery County.

Houston to Gulf Coast Water Authority Transfer—Water transfer strategy in which Houston would provide 28,000 ac-ft/yr to the GCWA in Galveston County, beginning in 2050. The GCWA then reallocates their existing Brazos River supply to meet demands in Fort Bend County. Included was a pumping station and pipeline to convey the water to the GCWA's Texas City reservoir.

Houston Indirect Wastewater Reuse—The City of Houston had applied for a water right permit to indirectly reuse up to 580,900 ac-ft/yr of wastewater discharges. A portion of that was recommended for direct reuse to industry. An additional 98,000 ac-ft/yr was recommended for use beginning in 2050.

NHCRWA Indirect Wastewater Reuse—The North Harris County Regional Water Authority was estimated to have the potential to indirectly reuse up to 157,000 ac-ft/yr of wastewater discharges. 31,400 ac-ft/yr was recommended for use beginning in 2060.

Lake Houston Additional Yield—Volumetric surveys and WAM analysis showed that Lake Houston could yield an additional 32,500 ac-ft/yr of supply (declining over time due to storage losses to sedimentation).

Freeport Seawater Desalination—A pilot plant is being considered under the Governors Desalination Initiative, with an initial capacity of 11,200 ac-ft/yr and a recommended increase to 33,600 ac-ft/yr.

Brazos Saltwater Barrier—A proposed gated structure on the lower Brazos above Freeport to protect lower basin intakes from the seasonal saltwater influence, which is expected to worsen as the basin is fully utilized.

Redesignation of Existing Water Rights—WWPs who identify local changes in water usage types due to development are recommended to add appropriate usage types to their water rights permits.

New San Jacinto River Water Rights—The SJRA and City of Houston have jointly applied for an interruptible supply permit on the San Jacinto River. The conjunctive use of this supply with existing supplies owned in the Trinity River Basin would reduce interbasin transfers in non-drought years.

New Harris County Bayous Water Rights—The City of Houston had applied for an interruptible supply permit in the lower San Jacinto basin. The conjunctive use of this supply with existing supplies owned in the Trinity River Basin would reduce interbasin transfers in non-drought years.

The 2006 Region H Water Plan met all projected water demands, at an estimated capital cost of $5.5 billion for the recommended water management strategies.

1.7.2 Unique Streams Segments Recommended in the 2006 Regional Plan

The Texas Water Code offers the opportunity to identify river and stream segments of unique ecological value. The selection criteria established within the Texas Water Code are as follows:

- Biological Function
- Hydrologic Function
- Riparian Conservation Area
- High Water Quality/Exceptional Aquatic Life/High Aesthetic Value
- Threatened or Endangered Species/Unique Natural Communities

Stream Segments designated by the legislature as having unique ecological value cannot be developed as reservoir sites by the State or any political subdivision of the State. After consideration of the above factors, the Region H 2006 Water Plan recommended the following eight streams for designation as Streams of Unique Ecological Value in Region H:

Table 1-16

Recommended Unique Stream Segments

Stream Segments (not in priority order)	County
Armand Bayou	Harris
Austin Bayou	Brazoria
Bastrop Bayou	Brazoria
Big Creek	Fort Bend
Big Creek	San Jacinto
Cedar Lake Creek	Brazoria
Menard Creek	Liberty, Hardin*, Polk
Oyster Bayou	Chambers

*(Hardin County is in Region I)

The entire stream segment length was recommended for Armand Bayou and Menard Creek (segment within Region H). For the remaining streams, only those portions adjacent to or within riparian conservation areas were recommended as unique streams. The unique stream segments have been designated by the Legislature in Senate Bill 3, Section 4.02.

1.7.3 Unique Reservoir Sites Recommended in the 2006 Regional Plan

The Texas Water Code offers an opportunity to designate sites of unique value for use as surface water supply reservoirs. Through use of a decision-based water management strategy analysis and selection process, the RHWPG selected two surface water reservoir projects, Allens Creek and Little River Off-Channel, for inclusion in the 2006 Regional Water Plan. Two additional reservoir projects, Bedias Reservoir and Little River Reservoir were recommended in the 2001 Plan but were replaced in the 2006 Plan by different water management strategies. The RHWPG had decided to recommend the locations of each of these projects as unique sites. In 2007 the Texas Legislature adopted the unique reservoir sites recommended in the 2007 State Water Plan, which were amended to the Texas Water Code.

The four sites were:

Table 1-17

Recommended Unique Reservoir Sites

Name	County	General Location
Allen's Creek	Austin	1 Mile N. of the City of Wallis
Little River, Off-Channel	Milam	Beaver Creek, approx. 5 Miles NE of City of Milano
Bedias	Madison (Principally)	Bedias Creek, 3.5 Miles W. of State Hwy 75
Little River	Milam	Main Stem of Little River, Immediately Upstream of its Confluence with the Brazos River

1.8 Regulatory, Administrative and Legislative Recommendations

Section 357.7(a)(10) of the Texas Water Development Board regional water planning guidelines requires that a regional water plan include recommendations for regulatory, administrative, and legislative changes. These recommendations are addressed to each governmental agency that has the appropriate jurisdiction over each subject. It is generally assumed that regulatory recommendations are directed towards the Texas Commission on Environmental Quality (TCEQ), that administrative recommendations are directed towards the Texas Water Development Board (TWDB), and that legislative recommendations are directed towards the State of Texas Legislature. The Region H Water Planning Group has currently adopted the following regulatory, administrative, and legislative recommendations:

1.8.1 Regulatory and Administrative Recommendations from the 2006 Plan

Clarify the agency rules to address consistency with the regional water plans.

Water rights applications must be consistent with the Regional Water Plans in order to be approved. The TCEQ has interpreted this to mean that the requested water right must be directly linked to a recommended water management strategy; otherwise the applicant has had to petition the RWPG for a plan amendment to add their permit application. RWPGs should not be required to formally adopt or amend the regional plan to include a proposed management strategy for water supply in order for new water rights applications to be evaluated by the TCEQ. This creates a situation that can deter the study of viable alternatives by agencies outside the RWPG and may ultimately block their ability to obtain permits for new supplies that the agencies need to meet their future needs. These alternatives may be preferable to existing management strategies (such as building reservoirs) that were previously recommended by the RWPG. A water right application that is not in conflict with the regional water plan (i.e., does not compete for supply allocated in the plan) should be considered consistent with the plan by the TWDB and TCEQ. If the strategy would benefit the region, it could then be added to the plan as a formal management strategy in the next five-year update, undergoing the full analysis, consideration and Public Hearing process.

The Region H Water Planning Group recommended that the Agency rules be amended to clarify the consistency requirement. Only those water rights applications in conflict with the current regional water plan should be referred to the RWPG for amendment.

Allow more flexibility in the allocation of alternate or multiple water management strategies to meet defined water shortages.

Section 357.7(a)(9) of the TWDB Regional Water Planning guidelines requires “specific recommendations of water management strategies to meet the needs…” The TWDB interpretation of these requirements suggests a direct relationship between a defined water shortage and a specific water management strategy. In reality, the WUG may have two or three possible suppliers that they could negotiate and choose between. Also, WUGs may form sub-regional groups to pursue more cost effective strategies than are achievable separately. This single-supplier option is a necessary assumption for the planning effort (so that the RWPG does not recommend more strategies than the region requires); however, it is unrealistic for the TWDB to hold the WUG to our recommended supplier. This bypasses the market and hinders competition. Correcting these WUG-Supplier associations in the plan (to allow TWDB funding assistance) requires a formal amendment and incurs costs related to that process. The RWPGs should not be placed in that position and the public should not bear that cost.

Additionally, WUGs and wholesale water providers may have several viable strategies to choose between. The RWPGs are limited to recommending the best or most feasible strategies, based upon the regional planning rules and assumptions. The individual WUG or WWP may opt to implement a

different viable strategy, based on their own analysis and differing assumptions and criteria. Currently, reflecting this change between viable alternatives requires amending the regional water plan. If alternative strategies could be fully analyzed and recognized in the plan when it is adopted, they could be exchanged with recommended strategies without requiring a full amendment.

The Region H Water Planning Group recommends that the TWDB and the TCEQ interpret existing legislation to give the maximum possible flexibility to WUGs and suppliers. Legislative and regulatory changes should be made to remove this requirement for specificity from the regional water planning guidelines and allow plans to present multiple sources of supply where appropriate. Alternative strategies should be designated in the plan, where appropriate, to remove the single-strategy restriction placed on water users groups.

Following the 2006 Planning process the Texas Water Code was amended to allow the regional planning group to substitute one or more evaluated strategies In the event that a strategy recommended in the 2006 Plan is no longer recommended, the group may substitute on or more alternative strategies. The substitution must be approved by the Executive Administrator. Alternative strategies must be evaluated to the same extent as recommended strategies.

Modify the notification procedures for amendments to regional water plans that only affect a portion of the region.

The same notification requirements associated with adoption of a regional water plan should not be used upon amendment of a specific component of the plan. Based on the number of WUGs within the region, the RHWPG anticipates a number of plan amendments will be requested during every planning cycle. The majority of these plan amendments will only affect certain aspects of the plan and certain communities and water suppliers. The current notification requirements for the entire plan are expensive.

The Region H Water Planning Group recommends adoption of a revised set of notification procedures for those regional water plan amendments that only affect a limited portion of the region.

Following the 2006 regional water planning cycle, a minor amendment process was added to the Regional Water Planning Process. The minor amendment process allows the Regional Planning Groups to amend portions of the plan that affect only a portion of the Plan.

Clarify agency rules on quantitative environmental analysis.

The Regional Water Planning Guidelines require that the evaluation of potentially feasible water management strategies include a quantitative analysis 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 (31TAC357.7.(a)(8)(A)). The TWDB has provided detailed guidance on specific study methods to be used in determining population, water demand, socioeconomic impacts and yield from current and proposed supply sources, but has not provided similar guidance in the area of environmental impacts. This lack of specificity is resulting in different methods being used in different regions. Additionally, it places the planning groups at risk of needing to conduct additional analysis after state agencies review the Initially Prepared Plans, and add those results to the report after the public review period has closed.

The Region H Water Planning Group recommends that the TWDB determine, in conjunction with the TCEQ and TPWD, which specific environmental studies and analysis is required for each category of management strategy (i.e., new water right, new reservoir, etc.), and that guidance be added to the Planning Guidelines so that RWPGs can reflect these requirements in their budgets and scopes of work, and so that plans are consistent across the State.

TDPES Permitting of Wastewater Reclamation Facilities.

Existing Texas Pollutant Discharge Elimination System (TPDES) permit requirements do not encourage, and in fact discourage, wastewater reuse and reclamation.

In terms of wastewater reuse (e.g., without further treatment), a violation of an end-user's discharge permit could be caused by using effluent to replace or supplement another water source. An example would be an industry, whose discharge is close to its permitted limit for a given constituent, exceeding that limit by virtue of its use of effluent from a separate wastewater treatment plant.

In terms of wastewater reclamation (e.g., with further treatment), permitting the discharge from a wastewater reclamation facility could be difficult and unnecessarily expensive. Wastewater reclamation often entails advanced treatment of wastewater discharged from one or more treatment facilities for industrial use. If this advanced treatment facility is separate, it requires a separate TPDES permit. Under current TCEQ rules, discharges from a new facility are considered as occurring *in addition to* all currently permitted discharges, for the purpose of assessing the collective effect on the receiving stream. While this is the correct procedure for evaluating a discharge from a new waste source, it effectively double-counts the waste load from a reclamation facility (once at the original plant, and again at the additional treatment facility). Designing a reclamation facility to sufficiently mitigate this double-counting is unneeded and may be cost-prohibitive. In actuality, the waste load should be divided between the applicable facilities, depending upon the reuse and reclamation demands.

Therefore, the permitting process should be modified to address both reuse and reclamation projects that draw effluent from existing wastewater plants, so that daily loads may be accurately assessed on a combined maximum daily load and maximum daily concentration basis, and permitted accordingly.

The Region H Water Planning Group recommends that the TCEQ modify the rules for wastewater permitting, so that the environmental impacts of reuse and reclamation facility discharges are assessed in conjunction with appurtenant reductions in discharges for their source water facilities.

1.8.2 Legislative Recommendations from the 2006 Regional Plan

Remove barriers to interbasin transfers of water within Region H.

Senate Bill One states that water rights developed as a result of an interbasin transfer become junior to other water rights granted before the interbasin transfer permit. The effect of this change is to make obtaining a permit for interbasin transfer significantly more problematic than it was under prior law and thus discourages the use of interbasin transfers for water supply. This is undesirable for several reasons:

- Current supplies greatly exceed projected demands in some basins, and the supplies already developed in those basins can only be used via interbasin transfers (i.e. Trinity Basin within Region H.)

- Interbasin transfers have been used extensively in Texas and are an important part of the state's current water supply. For example, three of the five Region H Major Water Providers (City of Houston, Trinity River Authority and San Jacinto River Authority) maintain current permits for interbasin transfers collectively of over 1,000,000 acre-feet per year. Virtually all future water demands within the San Jacinto basin (Harris County in particular) of Region H must rely on interbasin transfers.

- Emerging regional water supply plans for major metropolitan areas in Texas (Dallas-Fort Worth and San Antonio) rely on interbasin transfers as a key component of their plans. It is

difficult to envision developing a water supply for these areas without significant new interbasin transfers.

The Region H Water Planning Group recommends that the legislature revise the current law on interbasin transfers and remove the unnecessary and counterproductive barriers to such transfers that now exist.

Adopt the recommended stakeholder process for determining bay and basin environmental flow requirements, and include Region H and the Galveston Bay Freshwater Inflows Group (GBFIG) in the Galveston Bay stakeholder group.

Region H contains many water-dependant natural resources, most significantly Galveston Bay, which provide ecological habitat for native and migratory species. Under current water law, waters of the state belong to the environment until appropriated for another beneficial use. As basins become fully allocated, a method of establishing a minimum environmental flow for each stream or estuary must be established, both to protect the environment and to facilitate water planning.

The Study Commission on Water for Environmental Flows delivered an interim report to the 79th Legislature. In that report, the study commission recommended, among other things, that the study commission be reauthorized, and that the commission appoint a Bay/Basin Area Stakeholder group for each bay/basin ecological area of the state. Such a group would then take prescribed actions leading to the establishment of environmental flow "set-asides" for its bay/basin ecological area. These values would be reviewed on a ten-year basis. The commission recommended that Galveston Bay be included on the first round bay/basins list.

The Region H Water Planning Group endorses the stakeholder process and requests that Region H and the Galveston Bay Freshwater Inflows Group (GBFIG) be represented on the Galveston Bay BBAS.

In 2007, Senate Bill 3 took effect beginning the environmental flows allocation process. The process began with the creation of the Environmental Flows Advisory Group and the Texas Environmental Flows Science Advisory Committee to guide the statewide process. Two basin and bay area stakeholder groups have been formed to develop recommendations concerning environmental flow regime, associated policy considerations, and strategies to meet the flow recommendations that will impact environmental flows in Region H. The Trinity and San Jacinto Rivers and Galveston Bay Stakeholders Committee was appointed in July of 2008 and the Brazos River/Bay and Estuary Area Stakeholder Committee will be appointed by June 1, 2010.

Increase funding for the Bays and Estuaries programs of state resource agencies and for additional monitoring and research to scientifically determine freshwater inflow needs.

The RHWPG has adopted specific language associated with establishment of freshwater inflows to maintain the health and productivity of the bay. Galveston Bay is an important economic and recreational resource for our region. Current levels of funding within the State of Texas Bay & Estuary program are insufficient to continue the needed monitoring, study and development of management strategies for the bay.

The Region H Water Planning Group recommends establishment of additional funding to pursue necessary future efforts of the Galveston Bay & Estuary program.

Maintain the current rule of capture basis of groundwater law within Texas in all areas not subject to defined subsidence or groundwater conservation districts.

Groundwater is a vital resource within Region H. This is especially true within the rural counties of the region that are predominantly dependent on groundwater. Current groundwater law based on the

Rule-of-Capture has facilitated orderly development of groundwater systems throughout the State of Texas and, barring the intrusion of private interests, could continue to serve the water usage interests throughout the state. It appears that the Rule-of-Capture could continue per the status quo to serve the groundwater interests within the region.

The Region H Water Planning Group supports continued usage of the Rule-of-Capture as the basis of groundwater law throughout the State of Texas except as modified through creation of certified groundwater conservation districts.

Support development of Groundwater Conservation Districts to protect current groundwater users, and encourage these districts to study and manage aquifer storage and recovery.

Region H communities, particularly those within the rural areas of the region, are dependent on groundwater supplies. Groundwater is a very valuable resource to this region. Region H contains counties, specifically Austin, Leon and Madison where some municipalities, water supply corporations and property owners believe Groundwater Conservation Districts (GCD) are needed to retain long-term groundwater supplies within their respective counties. Region H also has several counties, including Brazoria, Waller and Montgomery, where groundwater supplies will, in theory, reach their maximum sustainable yield due solely to projected in-county water usage rates. A GCD is a potential vehicle for these counties to manage and protect groundwater supplies from over-development within each respective county. The potential of losing these supplies to outside interests before the county of origin can maximize the use of these supplies would create a burden on local water users.

The Region H Water Planning Group supports creation of GCDs, as necessary, by local subarea water interests. The RHWPG supports development of truly regional GCDs as opposed to single county districts to recognize the regional expansiveness of underground aquifers and to provide the greatest degree of regional water supply protections.

Senate Bill 2 of the 77th Legislature authorized the formation of four new GCDs in Region H (Bluebonnet, Brazoria County, Lone Star and Mid-East Texas).

Establish financing mechanisms for development of new water supply projects identified within the adopted regional water plans.

The Region H Regional Water Plan includes development of several surface water reservoirs and other supply projects. The capital cost to develop these projects is significantly higher than the historic cost of water supply projects. The projected costs are such as to dissuade local communities from making a financial commitment to support future projects. These financing issues will delay the implementation of needed projects.

To address this situation, the Region H Water Planning Group supports establishment of financing methods by the State of Texas to capitalize a fund to support development of water supply projects recommended within adopted regional water management plans.

Following completion of the 2001 Regional Plan, the Regions conducted an Infrastructure Financing Survey among their WUGs with projected infrastructure needs, and reported those results to the Legislature. This is now a required task within the cyclic regional water planning process.

Act on the RHWPG recommendations of unique stream segments and unique reservoir sites.

While the RHWPG adopted both unique stream segment and reservoirs, there appears to be some confusion on the definition and legislative intent of the designations for each of these elements. It is clear that conflicts may be created for stream segments that might be used for both water supply conveyance and recreational purposes. To assist in the adoption of future unique stream segments and/or unique reservoir sites the RHWPG requests additional legislative clarification.

The Region H Water Planning Group supports clarification and definition of the legislative intent of the unique stream segments and of the unique reservoir sites.

Senate Bill 2 of the 77th Legislature amended the Water Code to restrict political subdivisions from taking certain actions within unique stream segments and unique reservoir sites. Senate Bill 3 amended the Texas Water Code to adopt the unique stream segments and unique reservoir sites recommended in the 2007 State Water Plan.

Continue funding of the State of Texas Groundwater Availability Modeling effort.

Many areas of Region H are totally dependent on groundwater to support the long-term viability of these areas. The current Groundwater Availability Modeling effort is supported since it is the most comprehensive groundwater assessment and analysis effort of the previous 20 years. The current GAM effort, however, omits minor aquifers and other groundwater considerations that are vital for certain local communities.

The Region H Water Planning Group supports continued funding for the GAMs effort, and recommends comprehensive analysis of all groundwater resources within the state.

The TWDB, in conjunction with the USGS, is continuing the GAM process.

Establish funding for agricultural research into the area of efficient irrigation practices.

The Region H water management plan includes a number of irrigation conservation based water management strategies. It is apparent that adoption of irrigation conservation practices may benefit the irrigation and agricultural industry in addition to local communities that may take advantage of water supply savings resulting from irrigation conservation. Additionally, the RHWPG supports further research and development of water-efficient and drought-resistant crop and species.

The Region H Water Planning Group supports funding of research and development studies associated with the efficient usage of irrigation technologies and practices.

Implement the programs recommended by the Water Conservation Implementation Task Force.

The RHWPG strongly supports water conservation at all levels, and has incorporated it in the regional water plan as a management strategy. However, realizing advanced conservation savings in municipal county-other areas may be difficult, as these practices require some management, funding and oversight. While the RHWPG does not advocate a one-size-fits-all conservation program for the State of Texas, they recommend that the legislature address water conservation and provide some guidance and ability for county and local governments to implement these programs.

The Region H Water Planning Group supports water conservation and recommends that the legislature address and improve water conservation activities in the state.

The 78th Legislature appointed a Water Conservation Task Force to study water conservation policies and best management practices. The Task Force reported their results to the 79th Legislature in 2005.

Establish funding for research in advanced conservation technologies.

The Water Conservation Implementation Task Force identified numerous best management practices in TWDB Report 362 – Water Conservation Best Management Practices Guide. The Best Management Practices outlined that report were developed using information compiled from past

research and studies along with information provided by the task force members. Additional water-saving technologies may still be developed in the future.

The Region H Water Planning Group recommends that the State fund research into advanced conservation technologies.

Resolve the issues related to water rights permitting for indirect reuse, and advocate water reuse statewide.

The TCEQ water rights permitting process for wastewater reuse needs to be clarified. Conflicts exist between Texas Water Code Sections 11.042 and 11.046 regarding the permitting of indirect reuse water. Section 11.042(c) states that return flows, once introduced to the stream, are property of the State of Texas and are therefore subject to appropriation by others. However, Section 11.046(b) and (c) allow the owner of return flows to obtain a bed-and-banks permit to transport this water to a place of reuse. This leads to potential conflicts between downstream appropriators and those who wish to indirectly reuse effluent.

Furthermore, the TCEQ has issued some water rights permits based on the existence of return flows in the river, and in the adjudication process some claims were established based on return flows. Additionally, some bed and banks permits were issued with priority dates, while others were issued without priority dates. Because of these issues and the conflicts discussed above, it is difficult to analyze indirect reuse as a water management strategy. Due to these significant unknowns and outstanding questions, the benefits and yields from reuse projects cannot be accurately estimated under the current regulatory environment. Specific regulatory issues that need to be resolved or clarified are outlined below:

- A policy for establishing a priority date, if any, for an indirect reuse authorization (i.e., bed-and-banks authorization) should be developed.

- Conflicts between Texas Water Codes 11.042 and 11.046 relating to the ownership of return flows (water right holders, groundwater users, and the State) need to be resolved.

- A policy for establishing the method and technical approach for evaluating indirect reuse permits (i.e., “no injury” analysis, WAM Run 3, WAM Run 8, etc.) needs to be developed.

- Clarification regarding the ownership of return flows and the right to permit return flows for indirect reuse needs to be provided. The issue of third-party permitting of return flows needs additional clarification.

- Additional clarification regarding the notification requirements for reuse permits, addressing both new discharges and historically discharged effluent, should be developed to ensure the protection of existing water rights.

These above issues directly impact water management strategies recommended in the Region H Water Plan, and therefore regulatory clarification is required.

The RHWPG recommends that TCEQ resolve the issues related to the permitting of indirect reuse water rights. In addition, the RHWPG supports wastewater reuse as a management strategy, and recommended it be advocated statewide through targeted State funding or other incentives to promote reuse projects.

Establish flood damage liability limits for water supply reservoirs.

Flood control reservoirs are generally drawn down at the beginning of the annual wet season so that when large rain events occur, the runoff may be captured and later released more slowly into the receiving stream. These reservoirs therefore reduce downstream flood levels and prevent inundation in low areas. In contrast, water supply reservoirs are operated to capture and retain as much streamflow as allowable under their permits, in order to have supply available during periods of high demand. This practice results in less available storage volume to capture runoff during major storms. When a major storm event occurs upstream or above a water supply reservoir, the reservoir operator must sometimes release flood flows during and after the event to prevent flooding upstream of the reservoir or to prevent damage to the dam and other facilities associated with the reservoir. This flood flow can contribute to downstream flooding, but with most reservoirs, actually reduces the amount of flooding which would have occurred had the reservoir not been constructed.

In recent years, plaintiffs with property in the downstream floodplains have brought multiple lawsuits against major water supply reservoir operators. Some recent court decisions have held the operators liable for damages to the downstream properties. If this trend is allowed to continue, this will force insurance rates for these entities to rise and operational changes to occur that may result in less available water storage for periods of need. The net effect to water users will be an increase in the cost of surface water throughout the state.

Consider State legislation clarifying the liability exposure of reservoir operators for passing storm flows through water supply reservoirs.

Continue funding of the Regional Water Planning process.

It is apparent that the RWPGs will have to meet periodically to address changed conditions related to the adopted regional water management plans. Ongoing activities will include, but not be limited to:

- Consideration of additions and modifications to the adopted plans
- Serving as communications liaisons with the water user communities within each region
- Assisting in the reconciliation of inter-regional water issues

It will be necessary to consider additional funding to support maintenance of the RWPGs. Also, the administrative provisions of Senate Bill One and the subsequent policies that have been enacted should be reviewed to determine if the appropriate organizational structure exists to accomplish the work of the RWPGs. Additional funding should be developed to support technical studies necessary to support the needs of the RWPGs.

The Region H RWPG recommends that the TWDB request additional funding and adoption of the appropriate administrative procedures from the legislature to facilitate ongoing activities of the RWPGs.

The current round of Regional Water Planning is funded by the TWDB, with no requirement for local funding participation.

1.8.3 Infrastructure Financing Recommendations

Increase the funding of the State Participation Program as needed to allow development of water supply projects sized to meet projected long-term demands.

This program enables the TWDB to assume a temporary ownership interest in a regional project when the local sponsors are unable to assume debt for an optimally sized facility. Payments on the funds provided by the State are deferred until a customer base grows into the capacity it funded. The deferred interest payments do not accrue additional interest. By funding up to 50% of a project, the program helps the local sponsors optimize facility sizes and avoid later expansions and replacements.

This program will be extremely important for the development of the recommended water management strategies, as well as for water treatment and distribution systems. Large projects, particularly reservoirs, must be developed in anticipation of future demands due to the long periods of time required for planning, permitting, property acquisition and construction. For example, Bedias Reservoir, which would require a transmission system as well as the reservoir itself, was estimated to cost $194.3 million. The current customer base cannot support this high cost. The Bureau of Reclamation no longer funds the development of new water supply reservoirs and this project would not qualify for other federal funding. Therefore, the State Participation program is one of the few programs available to assist local sponsors with this water management strategy. Other reservoir projects within Region H could also experience similar financing issues.

The State Participation Program will also be important during the expansion of surface water service into areas affected by subsidence. As areas develop and implement Groundwater Reduction Plans it is expected that communities will develop plans for regional treatment and distribution systems to reduce costs. State participation in these facilities will allow them to be optimally sized at their inception. The State Participation Program offers the important advantage of reducing the unit costs for water service for both existing and future water users of the optimally sized facility.

The Region H RWPG recommends increased funding of the State Participation Program as needed to allow development of these water supply projects.

Increase the funding of the State Revolving Fund Programs in future decades, and expand the program to include coverage for system capacity increases to meet projected growth for communities.

These programs provide loans at subsidized interest rates for the construction of water treatment and distribution systems and for source water protection (DWSRF) and for wastewater collection and treatment systems (CWSRF). As the loans are paid off, the TWDB uses the funds to make new loans (thus the name Revolving Fund). State funds for the program receive a federal match through the Environmental Protection Agency. These loans are intended for projects to bring existing systems into compliance with rules and regulations, and are available to political subdivisions, water supply corporations and privately-owned water systems. Applications are collected at the beginning of each year, given a priority ranking, and funded to the extent possible. Projects not funded in a given year may carry forward into the next year's ranking.

These programs are important in that they assist sub-standard water systems in attaining the minimum water quality mandated by Federal and State regulations, but they are not intended to fund system expansions due to projected growth. However, these programs may apply to individual systems in the Region experiencing water quality declines, or to those systems affected by the changed standard for Arsenic. The SRF may also provide assistance to water providers with aging treatment systems and transmission lines.

The Region H RWPG recommends increasing the funding of this program in future decades, and expand the program to include coverage for system capacity increases to meet projected growth for communities.

Increase funding of the State Loan Program to allow financing of near-term infrastructure cost projections.

The State Loan Program provides loans to Political Subdivisions and Water Supply Corporations for water, wastewater, flood control and municipal solid waste projects. Payments are not deferred in this program as they are under the State Participation Program, and the interest rates are not subsidized as they are in the Revolving Fund Programs. These loans are available for both local projects and for the local sponsors of regional projects. Acquisition and construction of water treatment and distribution systems are eligible for funding. Loans are made on a first come, first served basis.

This program will be heavily utilized in groundwater-served areas introducing surface water to meet current and projected demands. The availability of groundwater across the region has allowed development to occur outside existing surface water service areas. As the limits of available groundwater are reached (sustainable yields and/or regulatory limits), surface water treatment and transmission systems must be constructed to meet future demands. The costs are significant in that they are required in a short time span, instead of initiated and expanded over time as they are in areas originally served by surface water. Where local rate payers cannot afford to directly pay for conversion costs, State loans offer a significant cost advantage over most commercial and many public funding options, using the State's high bond rating rather than the rating of the local sponsor.

The Region H RWPG recommends increasing the funding of this program to meet near-term infrastructure cost projections.

Increase funding of the Agricultural Water Conservation loan program, leverage Federal grant programs by providing the local matching share, and consider adding a one-time grant or subsidy program to stimulate early adoption of conservation practices by individual irrigators.

The Region H water management plan includes a number of irrigation conservation based water management strategies. It is apparent that adoption of irrigation conservation practices may benefit the irrigation and agricultural industry in addition to local communities that may take advantage of water supply savings resulting from irrigation conservation. Additionally, the RHWPG supports further research and development of water-efficient and drought-resistant crop and species.

The Region H Water Planning Group supports funding of research and development studies associated with the efficient usage of irrigation technologies and practices. Provide a mechanism to leverage Federal grant programs by providing the local matching share. Increase funding of this loan program and consider adding a one-time grant or subsidy component to stimulate early adoption of conservation practices by individual irrigators.

Continue State and Federal support of the Texas Community Development Program, and increase the allocation of funds for the Small Town Environment Program.

The Federal Community Development Block Grant program provides grants and loans to low-income communities for certain projects, including water and wastewater infrastructure. It is administered in Texas under the Office of Rural Community Affairs as the Texas Community Development Program. The Small Town Environment Program (STEP) under the TCDP provides water and sewer system grants to cities and counties not eligible for funding under the Colonias or Economically Disadvantaged Areas Programs (EDAP). Within Region H, there are no Colonias or EDAP-eligible communities, but STEP grants may be obtained.

The Region H Water Planning Group recommends continued State and Federal support of the Texas Community Development Program, and increase the allocation of funds for the Small Town Environment Program.

Increase funding of the Regional Water Supply and Wastewater Facilities Planning Program in anticipation of upcoming development throughout the state, and expand the program to include the costs for preliminary engineering design and development of detailed engineering cost estimates of recommended facilities.

This program provides planning grants to Political Subdivisions for studies and analyses to determine feasible alternatives for regional water supply and wastewater facility needs. The planning must include more than one service area or political subdivision to be considered regional. Grants are generally limited to 50% of the total cost, and cannot be applied to the preparation of state and federal permits, administrative or legal proceedings of regulatory agencies, or the preparation of engineering plans and specifications.

This grant program can assist in planning for local areas, particularly the unincorporated areas of each county. Local sponsors investigating the best means to serve their populations may join with neighboring communities and water providers and request a planning grant, thus reducing their individual planning costs. Determination of the optimal institutional arrangement between political subdivisions is one of the eligible study areas under this program. Should a regional facility prove to be the best solution for the group, they may elect to pursue additional support from the State Loan and Participation programs.

One limitation of the program is that it cannot be applied to the detailed facility planning or preliminary engineering design of the proposed facility. These early engineering phase costs can represent as much as 30% of the cost of the facility, and generally must be completed before accurate financial requirements can be defined. Inclusion of these costs in either the planning grant or pre-project loan programs would better help these small communities develop the projects they need.

The Region H Water Planning Group recommends increasing funding of this program in anticipation of upcoming development throughout the state, and recommends expanding the program to include the preliminary engineering design costs for recommended facilities.

Support continued and increased funding of the USDA Rural Utilities Service programs at the Federal level, and fund the State Rural Water Assistance Fund.

This Federal program provides loans and grants in rural areas and communities of up to 10,000 people for water, wastewater, storm water and municipal solid waste projects. The program is intended for communities that cannot obtain commercial loans at reasonable rates. Loans are made at or below market rates, depending upon the eligibility of the recipient. Grants can cover up to 75% of project costs when required to reduce user costs to a reasonable level. A separate program of Emergency Community Water Assistance Grants (up to $500,000 per project) is also available to communities experiencing rapid declines in water quality or quantity.

This program is similar to the state loan and revolving fund programs. It offers another option to small communities and rural areas unable to finance required infrastructure without assistance. However, this is a nationwide program, and the competition for available funds is correspondingly greater. Colonias and border areas are specifically identified as target areas for the grant portion of this program, and it is therefore in the State's interest to support its continued funding.

The TWDB was recently authorized by the 77th Texas legislature to establish a similar program at the state level. The Rural Water Assistance Fund will provide low-interest loans to municipalities, water districts and non-profit water supply corporations. The program is still under development and has not yet been funded.

The Region H Water Planning Group recommends continued support and increased funding of this program at the Federal level, and funding of the State Rural Water Assistance Fund.

Provide research grants for the study of current and upcoming desalination technologies available to wholesale and retail water suppliers. Continue to fund appropriate demonstration facilities to develop a customer base, and pursue Federal funding for desalination programs.

The RHWPG considered desalination of brackish groundwater as a potential water source, but did not include it in the final plan because this strategy was more costly than other strategies. However, the RHWPG recognizes that the cost of desalination technology is decreasing, and that this strategy may merit consideration in future plans. It would be helpful and appropriate for the state to establish a program promoting desalination research and development. Such a program might offer financial assistance or incentives for project implementation.

The Region H Water Planning Group recommends that a research and development program for desalination be established in Texas, and that it include financial assistance and/or incentives for desalination project implementation.

Governor Perry sponsored a seawater desalination initiative to study seawater desalination along the Texas Coast as a future source of supply.

Provide increased research grants to study and better develop drought-resistant crop species and efficient irrigation practices.

The Texas Water Development Board offers research grants to individuals or political subdivisions for water research on topics published in the Board's Request for Proposals. Eligible topics include product and process development.

In the Region H Water Plan, one recommendation to the legislature is to establish funding for agricultural research in the areas of efficient irrigation practices and funding for the development of water-efficient and drought-resistant crop and species. Irrigators cannot generally afford the increased cost of water when new supplies are developed in today's market. By reducing demand in a cost-efficient manner, small irrigators may be able to continue farming. This is another potential topic for the Water Research Program.

The Region H Water Planning Group recommends increased research grants to study and better develop drought-resistant crop species and efficient irrigation practices.

Support regulatory changes that will allow USACE to increase water supply storage in new reservoirs that they construct and manage, and investigate other alternatives for increased involvement of USACE in funding water supply projects.

The U.S. Army Corps of Engineers (USACE) builds and operates dams and reservoirs for flood control purposes under its Civil Works program. Congress authorizes funding on a project by project basis. Under current regulations, storage in these reservoirs may be used for present and future municipal and industrial water supply, but that portion of the project must be funded by a non-Federal agency. Also, only 30% of the M&I water storage may be allocated to future needs. The balance must supply existing water users, as the repayment schedule for non-Federal costs is capped at 30 years. USACE is also authorized to fund projects for navigation, water quality improvement and ecosystem restoration.

As a result of the first round of Regional Water Planning, the Texas Congressional Delegation requested a study on the potential for federal assistance with water supply in Texas. The Fort Worth District had recently published the Texas Water Allocation Assessment Report, which identifies those projects that USACE might participate in. Within Region H, only Bedias Reservoir might have

received USACE funding if the scope of the project had been modified to include flood control. Also discussed were potential modifications to existing reservoirs to increase water supply yields (these modifications are generally limited to a 15% increase in storage). A saltwater barrier to improve water quality in the Brazos River was also identified as a potential project. USACE also has the ability to provide planning assistance to states for regional water supply studies, particularly studies crossing state and international boundaries.

Limitations to USACE assistance with water supply projects are (1) current policy preventing the USACE from participating in single–purpose water supply projects, (2) USACE's inability to share the cost of water supply projects, and (3) the time required to move appropriations actions through the federal government. The Texas Congressional Delegation could pursue changes to the governing regulations to allow participation in water supply projects, or could increase the percentage of water supply storage for future use allowed in USACE projects. However, USACE civil works projects are authorized individually by Congress. If the project sponsor desires USACE assistance, an exception permitting that assistance might be authorized in the same appropriation bill. The latter option requires the sponsor to have a project champion in Congress.

The Region H Water Planning Group recommends supporting regulatory changes that will allow USACE to increase water supply storage in new reservoirs which they construct and manage, and investigate other alternatives for increased involvement by USACE in funding water supply projects.

Region H supports the forming of regional facilities and encourages the State to remove any impediments to these entities, including restrictions to the use of public/private partnerships. Additionally, the State Participation Program should be made available to these public/private partnerships and to private nonprofit water supply corporations.

As communities assess the growing costs of water infrastructure, economies of scale can be realized by combining the needs of water user groups into larger, more efficient water supply, treatment and distribution facilities. Regional facilities offer interconnections between existing systems, which can increase overall reliability. The individual system connections to these systems can be phased over time to meet regional demands with less impact on individual systems than each trying to individually expand. In areas where groundwater limits are being reached, regional groups can identify areas where surface water supply is most needed, and allow other areas to remain on groundwater systems. Sharing costs across a wide customer base keeps rates comparable between service areas.

A range of cooperative options exists, including formation of regional authorities, inter-local agreements, public-private partnerships, local government corporations and public contracting with a private regional supplier. The optimal arrangement between political subdivisions depends upon the specific project and the goals of the parties. Partnerships with private investors through public-private partnerships and direct contracting with privately-owned facilities offer an advantage of using private financing to meet part of the initial planning and construction costs. The regulations governing these partnerships must protect the public represented by the partnership, but if too restrictive, may prevent the partnership from realizing potential cost savings though the use of private-sector procurement and construction practices.

Consideration should be given to reducing procurement restrictions for Local Government Corporations to encourage the pooling of resources for funding regional projects. Also, existing assistance programs should remain available when political subdivisions enter into public/public or public/private partnerships.

The Region H Water Planning Group supports the forming of regional partnerships and encourages the State to allow them the greatest possible latitude for financing in their governing regulations. Additionally, the State Participation Program should be made available to these public/private partnerships and to private nonprofit water supply corporations.

Appendix 1A

Selected Bibliography by Topic

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