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3. Analysis of Current Water Supplies

3.1 Introduction

The available water supply within Region H includes both groundwater and surface water. Groundwater is provided from two major aquifers—the Gulf Coast and the Carrizo-Wilcox; and four minor aquifers—the Sparta, Queen City, Yegua-Jackson, and Brazos River alluvium. Primary surface water sources are reservoir storage and run-of-river (ROR) supply from the three rivers in the area—the Trinity, San Jacinto, and Brazos.

Much of the regional water demand is supplied by surface water. Of the total year 2000 water demand, over 70 percent, or 1,267,410 acre-feet, was supplied by surface water as found in the TWDB Year 2000 Water Use Survey. Surface water supplies are obtained from the Lake Livingston-Wallisville Salt Water Barrier System on the Trinity River; Lakes Conroe and Houston on the San Jacinto River; the Brazos River Authority/U.S. Army Corps of Engineers (BRA/COE) System; ROR flows from the Trinity, Brazos, and San Jacinto Rivers; the corresponding coastal basins; and some smaller tributaries and reservoirs. Groundwater supplies accounted for the remaining 30 percent of the total year 2000 water demand predominately supplied by the Gulf Coast aquifer.

This chapter summarizes the results of Task 3, and describes the resources available to the region and their allocation to Water User Groups (WUGs) throughout Region H. Also, to provide consistency and facilitate the compilation of the different regional plans, Texas Water Development Board (TWDB) required the incorporation of this data into a standardized online database referred to as TWDB DB07. Tables that contain this information are identified below and are located in the appendices accompanying this chapter.

- *Table 3A.1* – Current Water Supply Sources
- *Table 3G.1* – Current Water Supplies Available to Region H by City and Category
- *Table 3H.1* – Current Water Supplies Available to the Regional Water Plan Group by Wholesale Water Provider

Some of the information contained within this chapter is based on information published in *Chapter 1 – Description of the Region*. For a complete and detailed list of sources, see references for *Chapter 1*.

3.2 Identification of Groundwater Sources¹

3.2.1 Groundwater Aquifers

As presented in *Chapter 1*, groundwater resources in Region H consist of two major aquifers and four minor aquifers. The two major aquifers are the Gulf Coast aquifer and the Carrizo-Wilcox aquifer, with the Gulf Coast aquifer furnishing the majority of groundwater within the region south of Waller County. The four minor aquifers present are the Sparta, Queen City, Yegua-Jackson, and Brazos River alluvium aquifers.

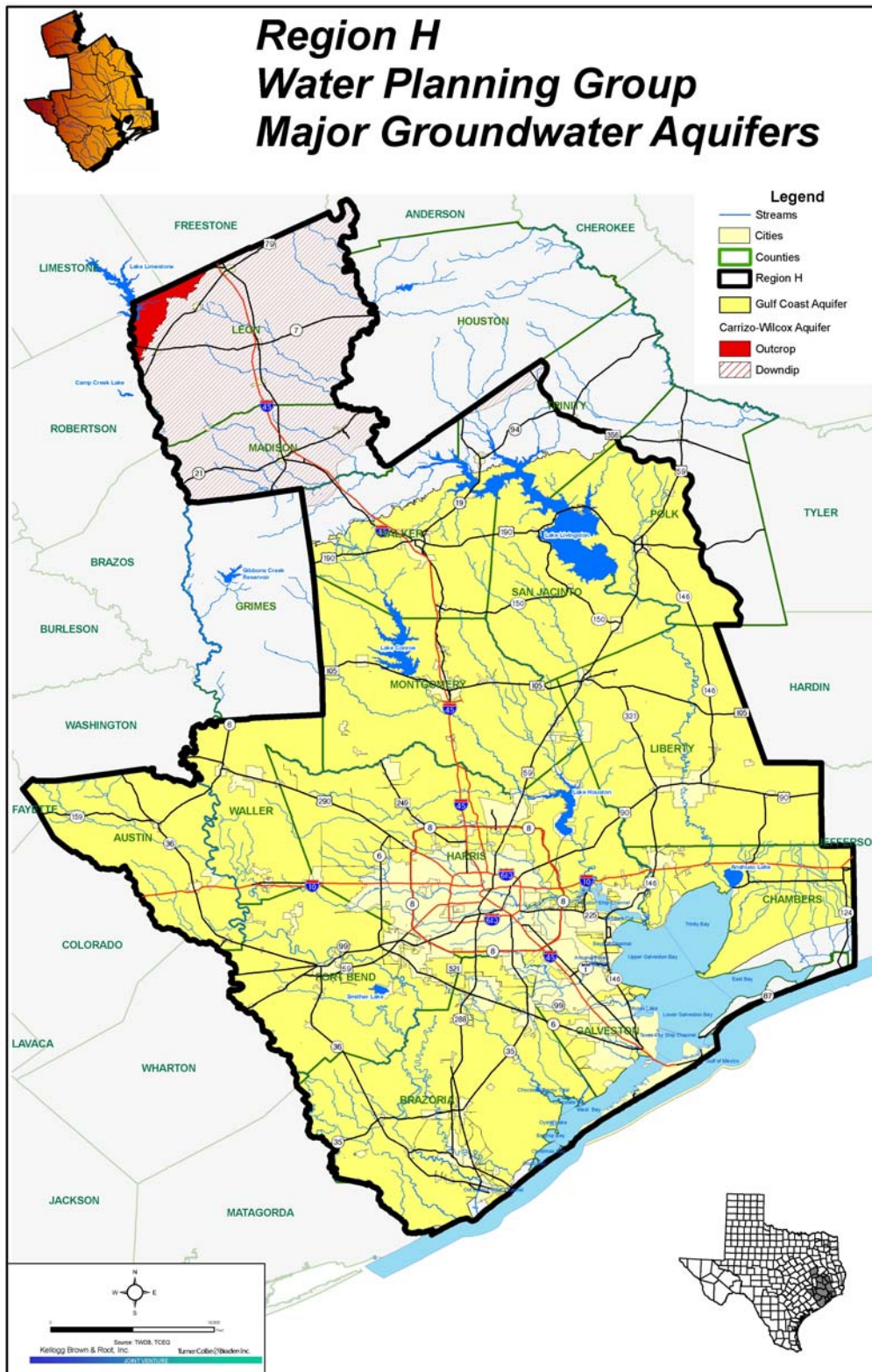
The Carrizo-Wilcox aquifer is the main aquifer in the northern part of Region H in Leon County and the northern portion of Madison County. The aquifer is composed of, in ascending order, the Wilcox Group and the Carrizo Formation. Because they are weakly connected hydraulically, they are generally described as one major aquifer, but for groundwater flow modeling purposes, the major aquifer is modeled as three separate layers. The Wilcox Group is composed of alternating beds of sand, sandy clay, and clay with locally interbedded gravel, silt, clay, and lignite. The Carrizo Formation is a uniform, well sorted sand that contains a few very thin beds of clay with the aquifer dipping downward to the southeast at about 70 to 100 feet per mile. The Carrizo-Wilcox aquifer supplies groundwater for domestic, municipal, manufacturing, and agricultural uses in Leon and Madison Counties. Figure 3-1: Major Groundwater Aquifers provides a map showing the location of the aquifer.

A groundwater availability model (GAM) was developed for the Carrizo-Wilcox aquifer in the area of Leon and Madison Counties and the model is described in a report prepared by the TWDB entitled *Groundwater Availability Model for the Central Part of the Carrizo-Wilcox Aquifer in Texas*. The model divides the Carrizo-Wilcox aquifer into four layers that are the Carrizo Sand or Carrizo Formation and the Calvert Bluff, Simsboro, and Hooper Formations of the Wilcox. The main layers of the model that provide substantial amounts of water are the Carrizo Sand and Simsboro. Utilization of the model provides an additional method to evaluate the groundwater resources in the northern part of Region H.

The Gulf Coast aquifer consists of four general water-producing units. The geologically youngest unit is the Chicot aquifer, followed by the Evangeline aquifer, the Jasper aquifer, and the Catahoula Formation. The Chicot and Evangeline aquifers are the more prolific water-producing units in the Gulf Coast aquifer followed by the Jasper aquifer and the Catahoula Formation. The aquifer extends from the Gulf Coast to approximately 100 to 120 miles inland in Walker and Trinity Counties. The units are composed of alternating beds of sand, silt, and clay, and at deeper depths shale can occur at and below the base of the Evangeline aquifer. Formation beds vary in thickness and composition. The areal extent and individual beds normally cannot be traced over extended distances. Total aquifer sand thickness varies and can be as great as several hundred feet. The Gulf Coast aquifer supplies groundwater for domestic, municipal, manufacturing, and agricultural uses in Austin, Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, Polk, San Jacinto, Trinity, Walker, and Waller Counties.

¹ The information contained in this portion of Chapter 3 was provided by LBG-Guyton Associates.

Figure 3-1: Major Groundwater Aquifers



A groundwater flow model is being developed for the Gulf Coast aquifer that includes the counties in Region H. A calibration version of the model has been published and a version for predictive runs should be released by February 2005. The model has four layers to represent the Gulf Coast aquifer, and these layers include Layers 1, 2, 3, and 4 representing the Chicot aquifer, Evangeline aquifer, Burkeville confining unit, and Jasper aquifers, respectively. The model provides an additional tool for evaluating the groundwater resources within Region H.

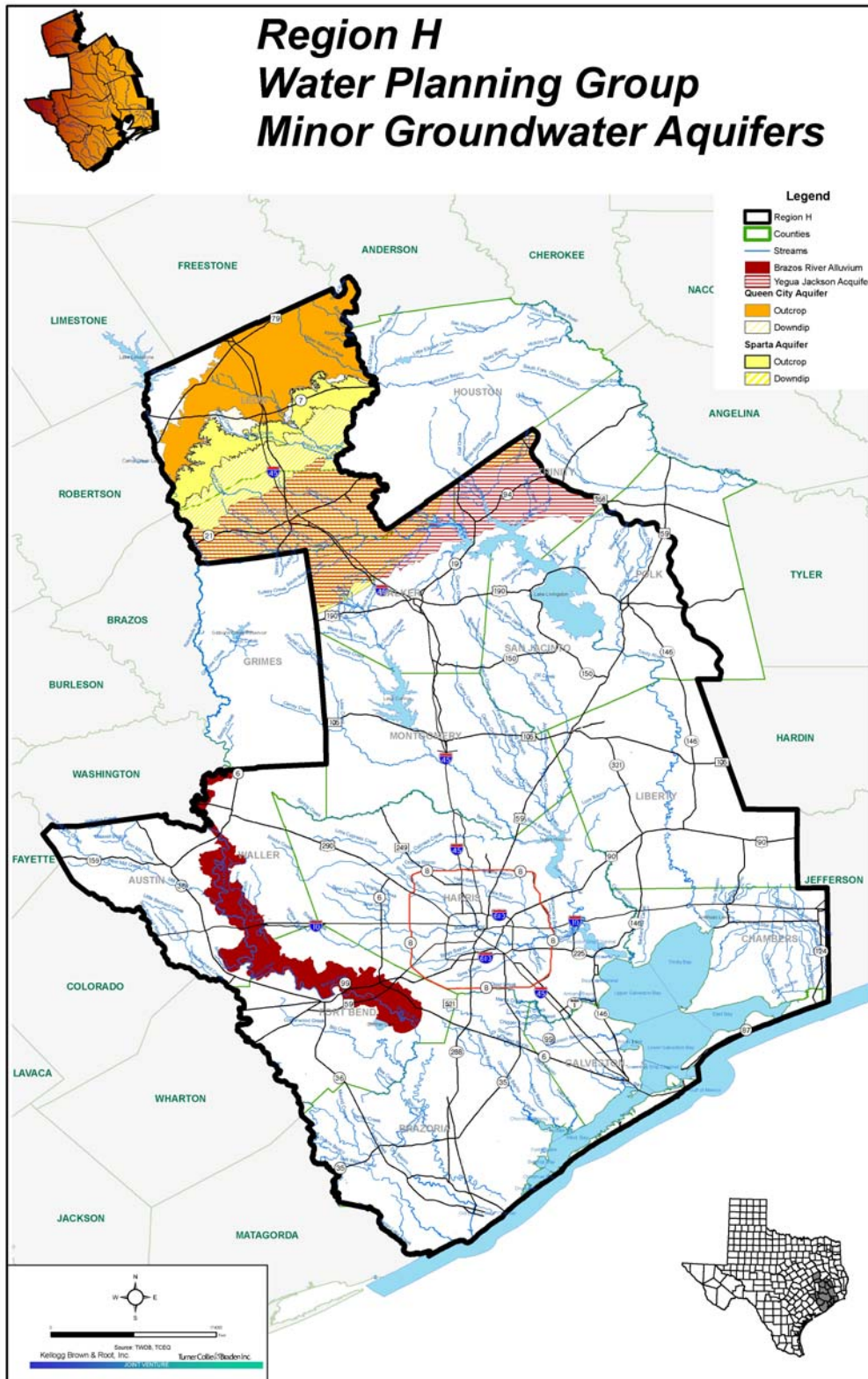
The Queen City Formation is a minor aquifer that occurs in central and southeastern Leon County and in the northern part of Madison County. The Queen City Formation is composed of sand and loosely cemented sandstone with interbedded shale layers occurring throughout. The Queen City Formation ranges in thickness from 250 to 400 feet with approximately 60 to 70 percent of the total thickness being sand according to Texas Water Commission Bulletin 6513, "Availability and Quality of Groundwater in Leon County, Texas, 1965" (Bulletin 6513). Groundwater in small to moderate quantities is provided by the Queen City Formation for domestic, municipal, industrial, and agricultural uses in Leon and Madison Counties.

The Sparta Formation or Sparta Sand is another minor aquifer that occurs in southeastern Leon County, all of Madison County, northwestern Walker County, and northeastern Trinity County. The Sparta Formation consists of sand and interbedded clay, with the lower portion of the aquifer containing massive unconsolidated sands with a few layers of shale. The Sparta Formation ranges in thickness from 200 to 300 feet in Leon County (Bulletin 6513) and Madison County. Groundwater from the aquifer is provided for domestic, municipal, and agricultural uses in Leon County and for domestic, municipal, manufacturing, and agricultural uses in Madison County. The Sparta Formation is the groundwater source for the Town of Madisonville.

The Yegua Formation and Jackson Group make up a minor aquifer, designated as the Yegua-Jackson aquifer that occurs within the region in parts of Madison, Walker, Trinity, and Polk Counties. The Yegua Formation consists of sand, interbedded clay, and scattered lignite. The Jackson Group includes all strata between the Yegua Formation and the Catahoula Sandstone and consists of sand, clay, sandstone, and siltstone. The Yegua Formation ranges in thickness from 1,000 to 1,500 feet, and the Jackson Group is approximately 1,100 feet thick according to Texas Board of Water Engineers Bulletin 5003, "Geology and Groundwater Resources of Walker County, Texas, 1950" (Bulletin 5003). Small to moderate quantities of groundwater are provided by the Yegua-Jackson aquifer for domestic, municipal, industrial, and agricultural uses.

The Brazos River alluvium is the fourth minor aquifer in the region. The Brazos River alluvium occurs in the floodplain and terrace deposits of the Brazos River in Austin, Fort Bend, and Waller Counties as shown on Figure 3-2: Minor Groundwater Aquifers. The Quaternary alluvial sediments consist of clay, silt, sand, and gravel according to TWDB Report 345, *Aquifers of Texas*, (1995) with the more permeable sand and gravel residing in the lower part of the aquifer. The saturated thickness of the sediment is as much as 85 feet with a width of the alluvium that ranges from less than 1 mile to approximately 7 miles

Figure 3-2: Minor Groundwater Aquifers



according to Report 345. The Brazos River alluvium supplies groundwater for domestic and agricultural purposes in Fort Bend and Waller Counties. In Austin County, it supplies groundwater for domestic, manufacturing, and agricultural uses.

Recharge to the two major and four minor aquifers is principally from the infiltration of precipitation and streamflow on the outcrops, as shown in Figure 3-3: Aquifer Outcrop Areas. A portion of the water infiltrates to the zone of saturation and then moves down dip through the aquifers, while large amounts of precipitation on the outcrops are rejected recharge and become runoff. Average annual precipitation in Region H ranges from about 40 inches/year in the northern area to about 50 to 54 inches in the southeastern area.

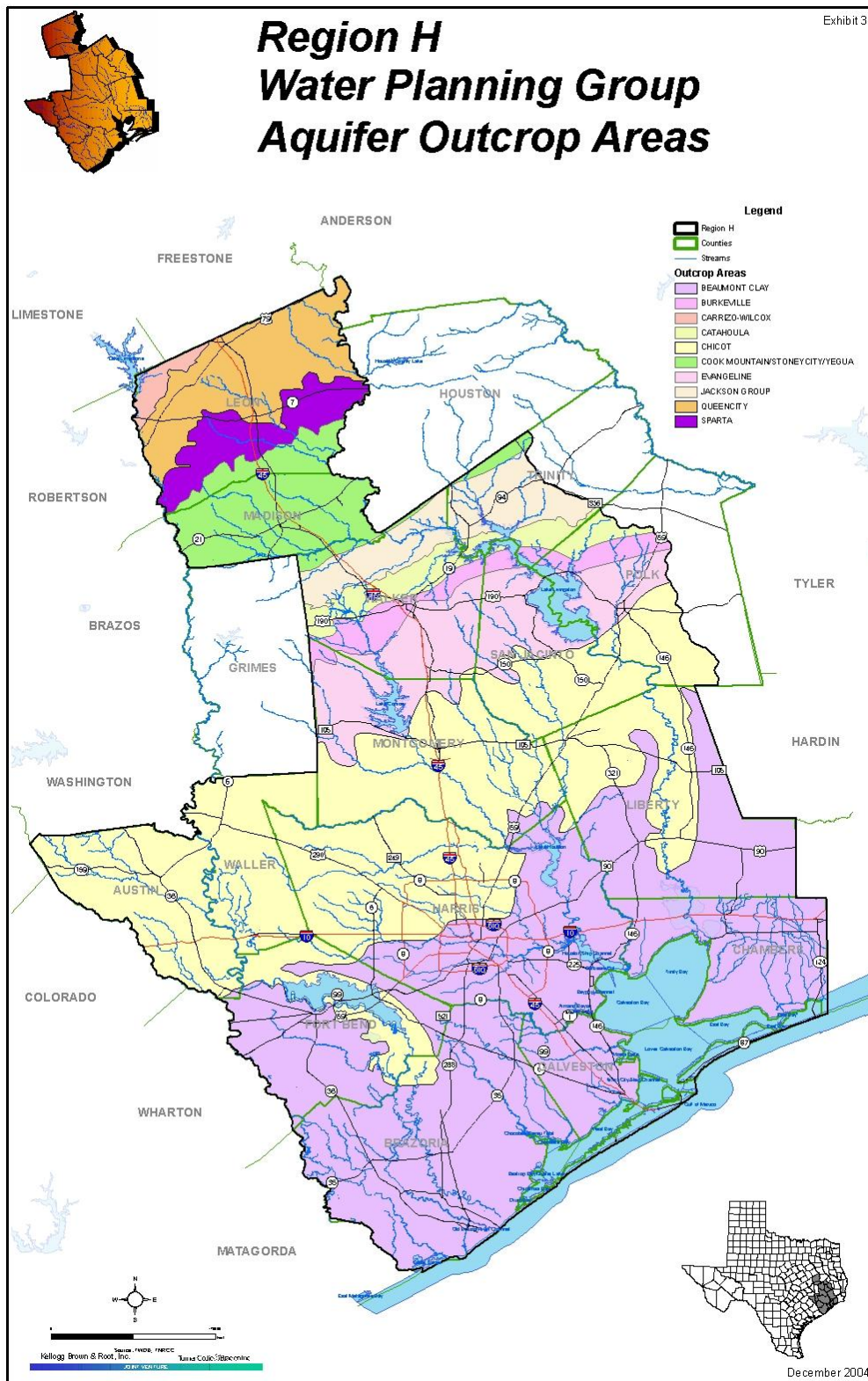
3.2.2 Groundwater Use Overview

According to TWDB and Harris-Galveston Coastal Subsidence District (HGCSD), Region H pumped approximately 671,566 acre-feet of groundwater in 2000. Groundwater in the region is used for domestic, municipal, manufacturing, steam-electric power cooling, and agricultural purposes. The majority of the water is used for municipal purposes. Municipal usage accounts for approximately 78 percent or 527,006 acre-feet of the water pumped. Municipal pumpage consists of water used for cities and communities, parks, campgrounds, and water districts serving principally residential developments. Agricultural usage accounts for approximately 14 percent or 92,953 acre-feet of the groundwater pumped. Major agricultural crops include rice, soybean, corn, cotton, and hay. Cattle are the principal livestock raised in the region. Finally, industrial usage represents approximately 8 percent or 51,607 acre-feet of the groundwater—water pumped for manufacturing, mining, steam-electric power, and other industrial needs. A majority of the overall groundwater usage is in the southern part of the region where more of the population, industrial, and agricultural demands exist and where the aquifer is capable of providing large quantities of water for the various uses.

3.2.3 Aquifer Conditions

Groundwater conditions within the region have been and should continue to be favorable for the pumping of substantial quantities of good quality water to help satisfy the multiple water needs of the region. The principal aquifers that will provide the water include the Carrizo-Wilcox in Leon and Madison Counties, the Sparta aquifer system in Madison and Trinity Counties, and the Gulf Coast aquifer system in the central and southern sections of the region. Smaller amounts of water can be provided by the Queen City, Sparta, Yegua-Jackson, and Brazos River alluvium aquifers with the minor aquifers being particularly important in areas that do not require large quantities of water to reliably meet demands.

Figure 3-3: Aquifer Outcrop Areas



3.2.3.1 Carrizo-Wilcox Aquifer

The Carrizo-Wilcox aquifer was deposited in a manner that resulted in a sequence of geologic formations with a thickness of about 2,000 feet in the northern part of the region. The Carrizo Sand, one of two principal water-producing units of the Carrizo-Wilcox aquifer, is about 100 to 200 feet thick. The Simsboro Sand is the other major water-producing unit, and it is about 200 to 400 feet thick. Currently, the overall availability of water from the Carrizo-Wilcox aquifer in Leon and Madison Counties is about 8,400 acre-feet per year based on the management plan adopted by the Mid-East Texas Groundwater Conservation District that includes Leon and Madison Counties. The estimate of groundwater availability for the two counties is substantially below a previous estimate by the TWDB of 165,900 acre-feet/year. The current estimate of 8,400 acre-feet per year will be reviewed in the upcoming years as additional information is developed for the Carrizo-Wilcox aquifer and groundwater pumpage occurs. In 2000, about 4,030 acre-feet of groundwater was pumped from the aquifer in the two counties based on data from TWDB. Conditions are favorable in the two counties to develop additional supplies from the Carrizo-Wilcox aquifer. The development should be done in a manner that will properly manage the aquifer and monitor its response to the stress of additional groundwater pumping. Water from the aquifer contains less than 1,000 milligrams per liter (mg/l) of total dissolved solids, but water from the Carrizo Sand can contain elevated levels of iron that require sequestering or treatment for removal for water used for most municipal and industrial purposes.

3.2.3.2 Gulf Coast Aquifer

The Gulf Coast aquifer was deposited in a manner that resulted in interbedded sand and clay layers with a substantial thickness of sand that contains freshwater of good quality. The lower unit of the aquifer, the Catahoula Sandstone, is screened by wells for the City of Huntsville. To the south in Galveston County, the Chicot unit is screened in wells used by the City of Galveston. The aquifer is capable of yielding larger quantities of water in the central and southern parts of Region H and has been utilized over the past 100 years to provide part of the water supply. The Gulf Coast aquifer has sand thicknesses ranging from about 200 to 500 feet in the central and southern parts of the region with the sands containing freshwater decreasing in thickness within about 30 to 40 miles of the Gulf Coast.

The pumpage of large quantities of water in the southern part of the region has caused the aquifer potentiometric head to decline from 50 to about 400 feet in parts of Harris County. Subsidence of significant proportions has occurred in parts of Harris and Galveston Counties resulting in the gradual reduction and shift in areal extent of groundwater pumping to the west over the past 25 years. Subsidence is discussed in the next section of this report.

Digital groundwater flow models have been developed over the past 25 years for the Chicot and Evangeline aquifers in the southern part of Region H to help assess the groundwater resources. As mentioned previously, the most recent digital model was developed by the U.S. Geological Survey for the TWDB with a report regarding the model titled “Hydrogeology and Simulation of Ground-Water Flow and Land-Surface Subsidence in the Northern Part of the Gulf Coast Aquifer System, Texas.”

3.2.3.3 Queen City and Sparta Aquifers

The Queen City and Sparta aquifers occur in the northern part of the region and are capable of providing some water in Leon, Madison, and Trinity Counties, and the northern part of Walker County. Estimated overall availability from the aquifers is about 25,525 acre-feet/ year based on groundwater supply data from TWDB. Water availability estimates from the Queen City and Sparta aquifers for the year 2000 are approximately 12,455, 10,790, 245, and 2,035 acre-feet per year in Leon, Madison, Trinity, and Walker Counties, respectively. The two aquifers are composed of sands that can provide small to moderate quantities of water to wells. The water-transmitting capabilities of the aquifers are limited but adequate for meeting smaller demands (pumping rates of 50 to 1,000 gallons per minute [gpm]). The aquifers contain water with less than 1,000 mg/l of total dissolved solids to depths that range from about 800 to 1,000 feet. Pumping from the two aquifers in Leon and Madison Counties in the year 2000 was about 3,500 acre-feet based on data from TWDB. No pumpage was recorded in the year 2000 TWDB data for either aquifer for Trinity and Walker Counties.

3.2.3.4 Yegua-Jackson Aquifer

The Yegua-Jackson aquifer is located in the northern part of the region and is capable of providing some water in Madison, Polk, Trinity, and Walker Counties. However, estimated water availability and usage specifically for the Yegua-Jackson aquifer has not yet been determined by the TWDB for these counties. Each of these counties has data available for other-undifferentiated aquifers. According to the year 2000 TWDB data, the total amount used in these four counties in this category was approximately 3,100 acre-feet.

The aquifer is composed of sands that can provide small to moderate quantities of water to wells. According to TWDB estimates in the 2002 Texas State Water Plan, yields of most wells completed in the Yegua-Jackson aquifer are small, less than 50 gpm, and net fresh water sands are generally less than 200 feet at any location within the aquifer. The quality of the water in the aquifer ranges from good to slightly saline. The plan also estimates that the entire Yegua-Jackson aquifer in the state produced about 11,000 acre-feet of water in 1997.

3.2.3.5 *Brazos River Alluvium*

The Brazos River alluvium is a shallow aquifer that is about one to seven miles wide in a corridor along the Brazos River in Waller, Austin, and Fort Bend Counties. The aquifer typically is not greater than about 100 feet deep with wells mostly constructed to provide water for irrigation of row crops and hay. The aquifer may contain water with total dissolved solids that approach 1,000 mg/l and a high total hardness due to the amounts of calcium, magnesium, and sulfate. Based on estimates from TWDB, the overall availability of water from the Brazos River alluvium in Austin, Waller, and Fort Bend Counties is about 41,500 acre-feet per year with 2000 pumpage in Fort Bend County estimated at 8,737 acre-feet per year by TWDB. No pumpage was recorded in the 2000 TWDB data for either Austin or Waller Counties. The aquifer should continue to be able to provide water for use along the Brazos River.

3.2.4 Subsidence Effects

Subsidence has occurred principally in Harris, Galveston, Brazoria, Fort Bend, and Chambers Counties as the result of the withdrawal of large quantities of groundwater from the Chicot and Evangeline aquifers. Studies and reports prepared by the U.S. Geological Survey and the HGCSO show that about 9-plus feet of subsidence occurred in a small part of the Houston Ship Channel area with fewer amounts away from the channel area. In the City of Katy, total subsidence through the year 2000 is estimated to be about 1.7 feet. In the City of Rosenberg in Fort Bend County, estimated subsidence is less than 1 foot through 2000. HGCSO has developed regulatory plans that have been updated through the years. Groundwater pumping in Harris and Galveston Counties has decreased over the past 23 years as additional surface water was utilized and less groundwater was pumped.

A regulatory plan adopted by HGCSO in 1999 prescribes general areal pumpage limits for the next three decades until 2030. The regulatory plan pumping requirements were used in estimating the availability of groundwater within the Harris and Galveston Counties area with the estimate of groundwater availability in 2010 being 346,040 acre-feet and decreasing to 228,975 acre-feet per year by 2030. HGCSO regulatory plan essentially segments Harris and Galveston Counties into geographic regions and mandates a reduction in groundwater pumpage per a scheduled reduction timeline. Water users located within the southeastern portion of Harris County and all of Galveston County currently must receive no more than 10 percent of their total water supply from groundwater. This limit or another limit adopted by HGCSO will exist throughout the Region H planning period. The remainder of Harris County is segmented within two other regulatory regions. Water users within Regulatory Area 2, which comprises the central portion of the county, must receive no more than 20 percent of their water supply from groundwater as of year 2000. Groundwater users within the remainder of Harris County, within HGCSO Regulatory Area 3, can receive only 70 percent of their water supplies from groundwater by year 2010, 30 percent of their water as groundwater by year 2020, and only 20 percent of their water supply from groundwater by year 2030. These regulatory limitations affect all of the WUGs (except irrigation for agricultural purposes and livestock uses) within Harris and Galveston Counties by year 2010,

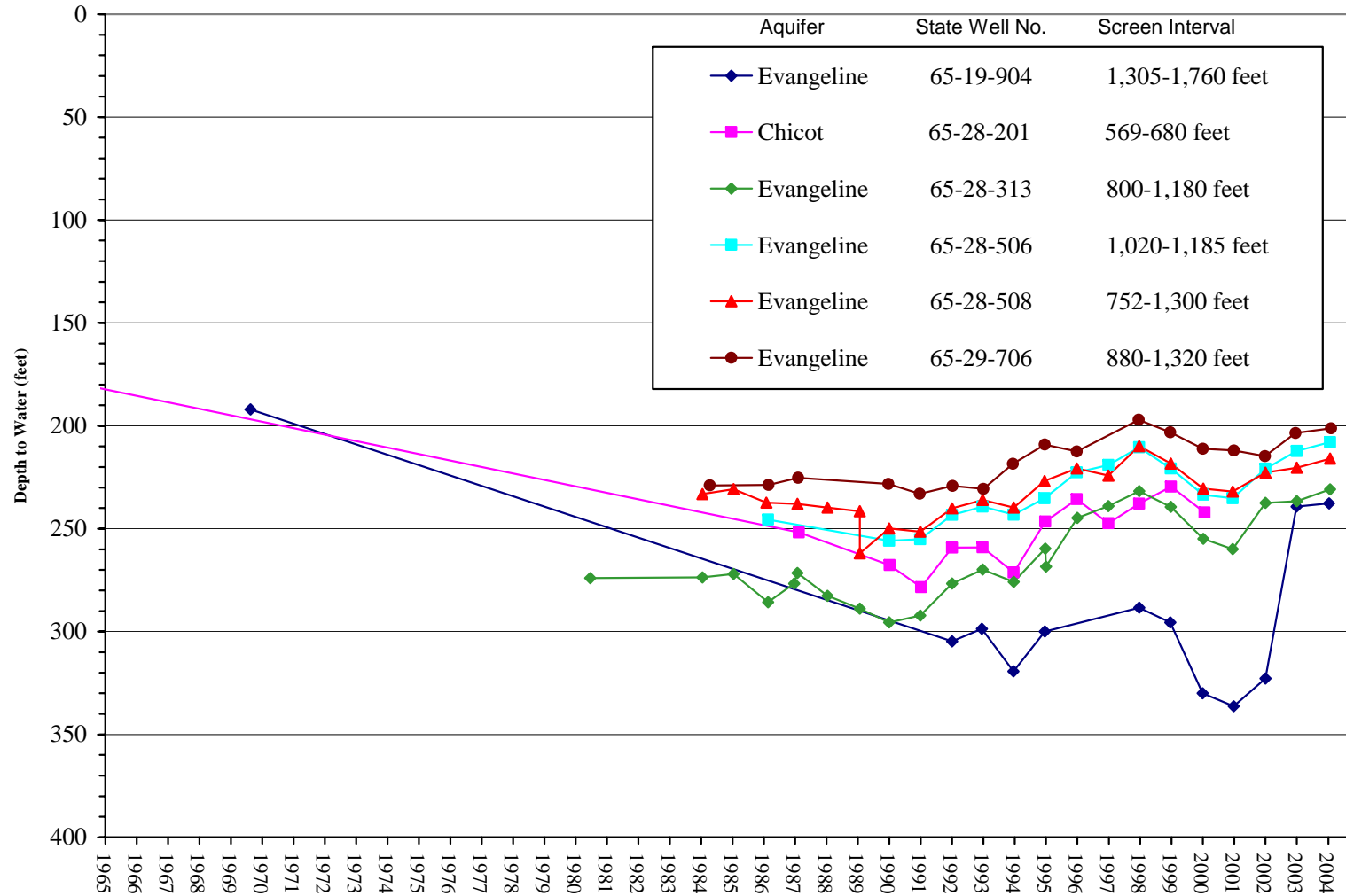
causing a continuing decrease in the allowable amount of groundwater that can be pumped in these two counties over time.

A regulatory plan adopted by the Fort Bend Subsidence District (FBSD) in 2003 also prescribes general areal pumpage limits for the next three decades until 2030 for Fort Bend County. The plan includes pumping limits to control subsidence within the District as needed. The FBSD regulatory plan essentially segments Fort Bend County into geographic regions and mandates reductions of groundwater pumpage per a scheduled reduction timeline. Water users located within the northwestern portion of Fort Bend County (Area A) must receive no more than 70 percent of their total water supply from groundwater by 2013 and 40 percent of their water as groundwater by year 2025. This limit or a more stringent limit adopted by FBSD will exist throughout the Region H planning period. Water users within the Richmond/Rosenberg Sub Area, which comprises the central portion of the county, must receive no more than 70 percent of their water supply from groundwater as of year 2015 and 40 percent of their water as groundwater by year 2025. Groundwater users within the remainder of Fort Bend County, FBSD Regulatory Area B, must be permitted for increases in withdrawal but are not currently subject to groundwater reduction requirements. These regulatory limitations affect all of the WUGs (except irrigation for agricultural purposes) within Fort Bend County by year 2013 or 2015, causing a decrease in the allowable amount of groundwater that can be pumped in the county over time.

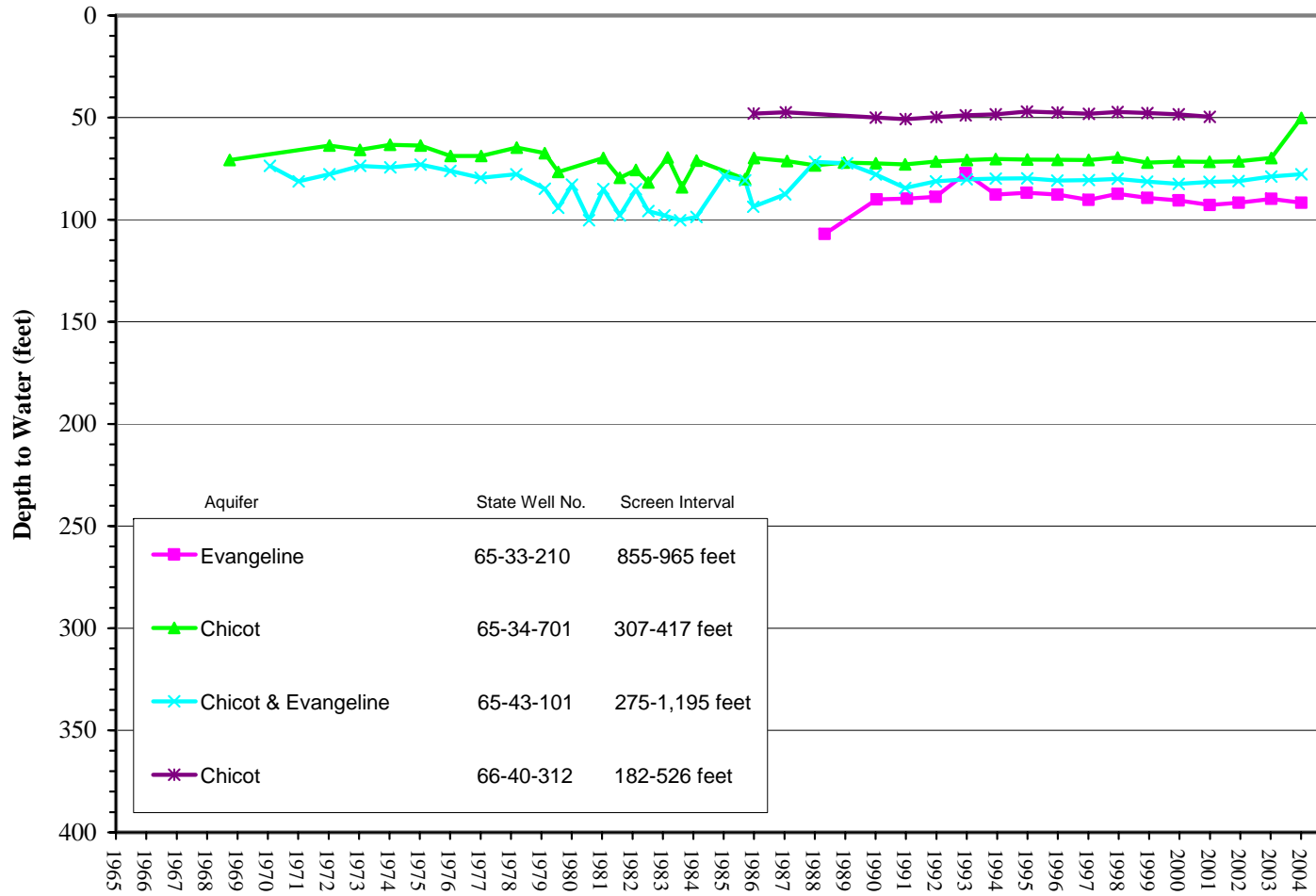
3.2.5 Groundwater Availability in Fort Bend and Montgomery Counties

Groundwater pumpage in Fort Bend County has been increasing over the past years from approximately 69,000 acre-feet per year in 1990 to about 88,000 acre-feet per year in 2002, based on data provided by FBSD. Groundwater availability for the county was estimated by FBSD at about 109,300 acre-feet per year from the Gulf Coast aquifer in the year 2000, and reduced to 89,600 acre-feet per year in 2030. Over the past 10 years, static water levels within the county in observation wells have been stable or showed a slight water-level recovery in eastern, southern, and western Fort Bend County. In the northern part of Fort Bend County, there has been about 30 to 35 feet of water-level decline over the past 10 years in some Evangeline aquifer screened wells (refer to Figure 3-4 through Figure 3-7).

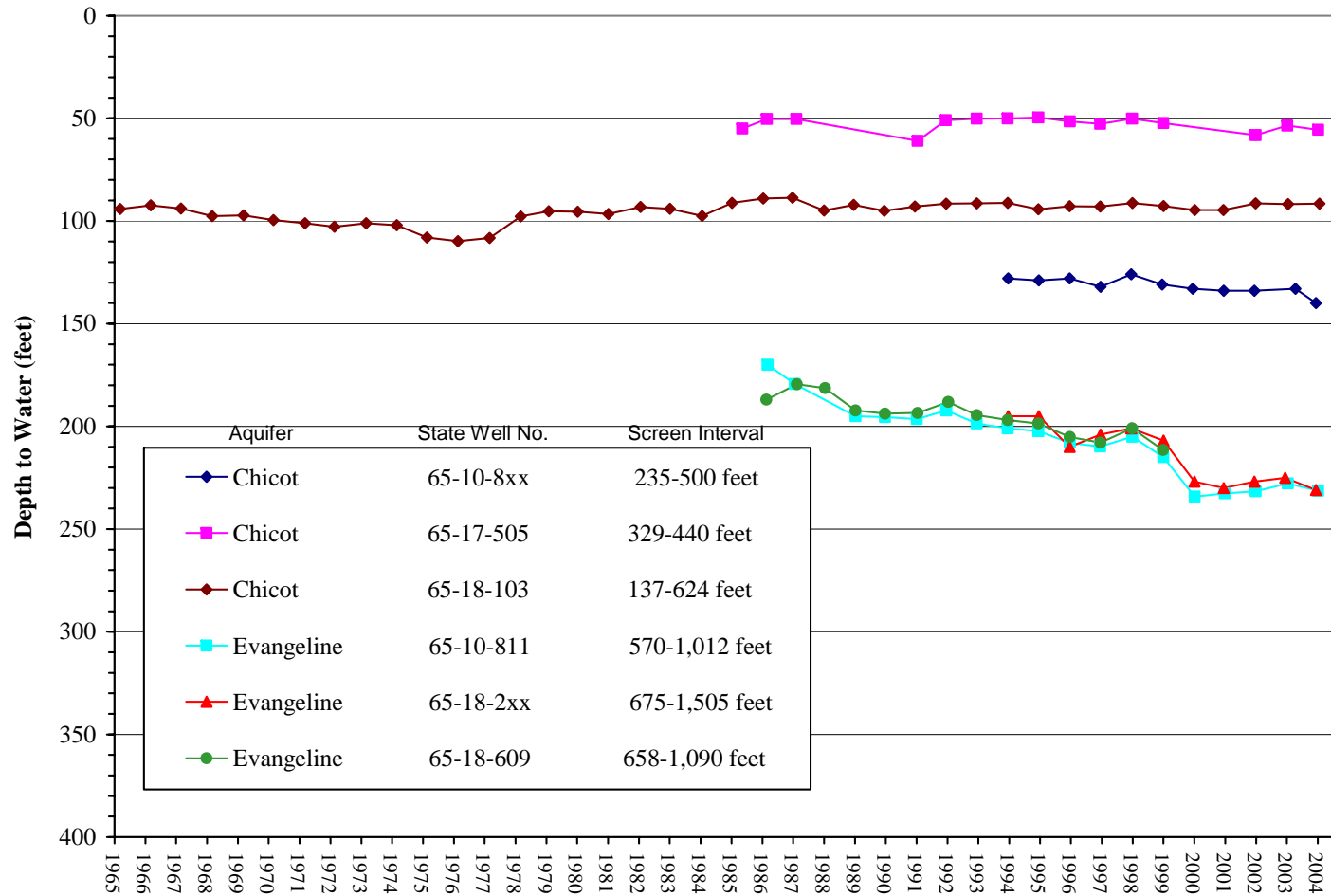
**Figure 3-4:
East Fort Bend County – Static Water Levels in Wells**



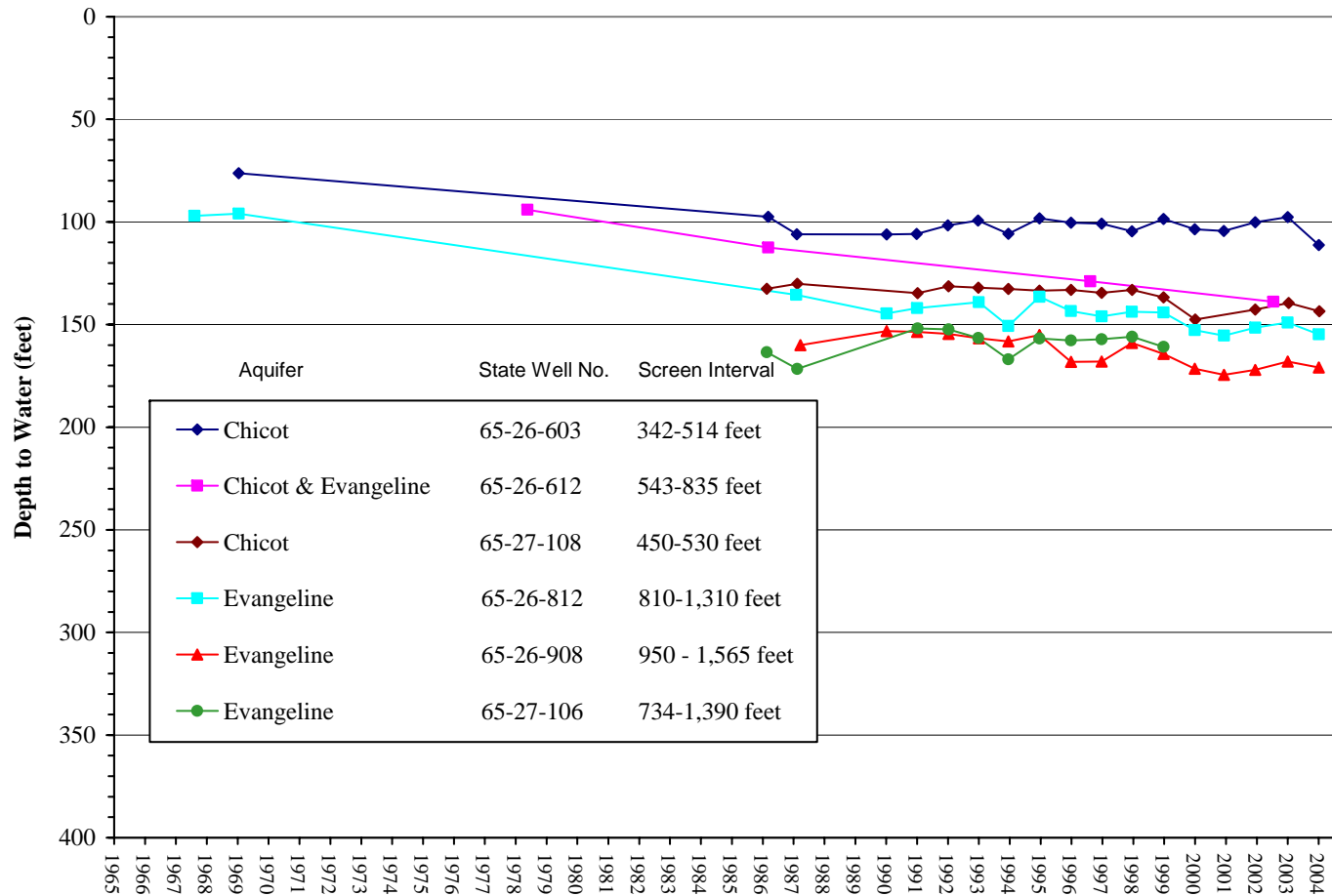
**Figure 3-5:
Southwest Fort Bend County – Static Water Levels in Wells**



**Figure 3-6:
 North Fort Bend County – Static Water Levels in Wells**



**Figure 3-7:
Central Fort Bend County – Static Water Levels in Wells**



The Gulf Coast aquifer provides groundwater to Montgomery County with the Jasper aquifer the principal source for about three-quarters of the county, and the Chicot and Evangeline aquifers providing water in the southeastern and very southern part of the county. The estimated groundwater availability from the Gulf Coast aquifer is about 64,000 acre-feet per year, based on the groundwater management plan adopted by the Lonestar Groundwater Conservation District. Pumpage within the county was about 55,990 acre-feet in 2000, based on data from TWDB. Pumpage is concentrated in the central and southern parts of the county along the Interstate Highway 45 (IH 45) corridor, around Lake Conroe, and in the southeastern part of the county north of the City of Humble.

The estimated availability of groundwater within Montgomery County from the Gulf Coast aquifer is about 64,000 acre-feet per year. Past pumpage and subsequent aquifer response to pumpage show that the development of additional groundwater will cause further potentiometric head decline in wells. Groundwater pumpage should be spread through the county to take advantage of developing water in areas where aquifer conditions are favorable but where the demand has not developed for the water, which is principally in the western and eastern portions of the county away from the IH 45 corridor area.

3.2.6 Public Supply Groundwater Usage

Region H relied on groundwater to provide approximately 50 percent or 527,006 acre-feet of the municipal water supply in 2000. Austin, Leon, Liberty, Madison, Montgomery, and Waller Counties relied on groundwater to supply essentially 100 percent of the domestic and municipal demand. Table 3-1 gives the amount of groundwater pumped for municipal purposes for each county in the region as reported by TWDB. Within the region, Harris County accounted for the most municipal groundwater usage in 2000 with 337,837 acre-feet. The next highest demands are Fort Bend County with 68,257 acre-feet, Montgomery County with 52,333 acre-feet, and Brazoria County with 26,796 acre-feet. Municipal users represent cities and communities, parks, campgrounds, and any water districts. The year 2000 had precipitation below normal for the year and during the summer months, so groundwater pumpage in 2000 was higher than normal.

Cities with populations of 1,000 or greater and county-other users that rely on groundwater for at least part of their overall supply are identified in *Table 3G.1*, located in *Appendix 3G*. The amount of groundwater projected to be available to the users can vary through the planning period depending on the demand for water by a user and whether surface water is needed or available in future years to satisfy part of the demand.

3.2.7 Industrial Groundwater Usage

According to TWDB and HGCSO, in 2000, Region H relied on groundwater to provide approximately 8 percent of the water used for industrial purposes, which accounted for approximately 51,607 acre-feet of the groundwater used in Region H. Industrial consumption represents water that is used for manufacturing, mining, and steam-electric power. Table 3-2 shows the amount of groundwater used for industrial purposes for each county in the region. Within the region, Harris County accounted for the most industrial

groundwater usage in 2000 with approximately 20,800 acre-feet. The next highest users were Fort Bend with 9,670 acre-feet, Liberty with 8,952 acre-feet, and Chambers with 4,063 acre-feet.

3.2.8 Agricultural Groundwater Usage

According to TWDB and HGCSO, in 2000, Region H relied on groundwater to provide approximately 32 percent of the water used for agricultural purposes. This equaled approximately 14 percent or 92,953 acre-feet of the total groundwater used in the region. Agricultural usage represents water that is used for livestock purposes and irrigation of crops. The main agricultural crops in the region include rice, cotton, and soybeans in the south and corn, cotton, and hay in the north. Cattle are the principal livestock raised. Table 3-3 shows the amount of groundwater used for agricultural purposes for each county in the region. Within the region, Fort Bend County accounted for the most agricultural groundwater usage in 2000 with 24,971 acre-feet. The next highest user is Waller County with 22,765 acre-feet followed by Harris County with approximately 20,800 acre-feet.

**Table 3-1:
Municipal Groundwater Demand From 2000 TWDB Data**

County	Total Groundwater Used (acre-feet)	Groundwater Used for Municipal Purposes (acre-feet)	Percent of County's Total Groundwater Used for Municipal Purposes	Percent of County's Municipal Water Demand Supplied by Groundwater
Austin	13,004	3,569	27.4	100.0
Brazoria	36,925	26,796	72.6	66.9
Chambers	6,355	2,014	31.7	45.5
Fort Bend	102,898	68,257	66.3	98.8
Galveston	5,791	5,163	89.2	14.0
Harris	379,209	337,837	89.1	42.1
Leon	4,849	1,883	38.8	100.0
Liberty	22,113	9,401	42.5	100.0
Madison	3,180	2,621	82.4	100.0
Montgomery	55,403	52,333	94.5	100.0
Polk	4,626	3,952	85.4	68.0
San Jacinto	2,931	2,742	93.6	96.8
Trinity	1,370	1,200	87.6	65.6
Walker	5,386	4,625	85.9	31.4
Waller	27,526	4,613	16.8	100.0
Total	671,566	527,006	78.5	

**Table 3-2:
Industrial Groundwater Demand From 2000 TWDB Data**

County	Total Groundwater Used (acre-feet)	Groundwater Used for Industrial Purposes (acre-feet)	Percent of County's Total Groundwater Used for Industrial Purposes	Percent of County's Industrial Water Demand Supplied by Groundwater
Austin	13,004	204	1.6	97.6
Brazoria	36,925	2,139	5.8	1.9
Chambers	6,355	4,063	63.9	8.8
Fort Bend	102,898	9,670	9.4	13.7
Galveston	5,791	200	3.5	0.5
Harris	379,209	20,800	5.5	6.8
Leon	4,849	1,410	29.1	61.7
Liberty	22,113	8,952	40.5	100.0
Madison	3,180	211	6.6	100.0
Montgomery	55,403	2,800	5.1	62.1
Polk	4,626	419	9.1	79.4
San Jacinto	2,931	75	2.6	100.0
Trinity	1,370	8	0.6	100.0
Walker	5,386	508	9.4	20.1
Waller	27,526	148	0.5	100.0
Total	671,566	51,607	7.7	

**Table 3-3:
Agricultural Groundwater Demand From 2000 TWDB Data**

County	Total Groundwater Used (acre-feet)	Groundwater Used for Municipal Purposes (acre-feet)	Percent of County's Total Groundwater Used for Municipal Purposes	Percent of County's Agricultural Water Demand Supplied by Groundwater
Austin	13,004	9,231	71.0	75.5
Brazoria	36,925	7,990	21.6	8.0
Chambers	6,355	278	4.4	0.7
Fort Bend	102,898	24,971	24.3	49.9
Galveston	5,791	200	3.5	3.9
Harris	379,209	20,800	5.5	89.8
Leon	4,849	1,556	32.1	69.7
Liberty	22,113	3,760	17.0	13.0
Madison	3,180	348	10.9	40.0
Montgomery	55,403	270	0.5	46.9
Polk	4,626	255	5.5	54.0
San Jacinto	2,931	114	3.9	12.0
Trinity	1,370	162	11.8	18.6
Walker	5,386	253	4.7	40.0
Waller	27,526	22,765	82.7	98.4
Total	671,566	92,953	13.8	

3.2.9 Groundwater Drought Susceptibility

The aquifers within Region H generally have low transmissivity rates and are less susceptible to drought because the static water levels do not fluctuate drastically during a severe drought. In general, Region H water suppliers have established drought triggers for their groundwater systems as a function of system capacity (pumps, storage, etc.) as opposed to other regions where static aquifer groundwater levels are used as drought triggers.

3.2.10 Groundwater Availability Summary

Groundwater has been an important water resource within Region H for the past 100 years. The major Carrizo-Wilcox and Gulf Coast aquifers and minor Sparta, Queen City, Yegua-Jackson, and Brazos River alluvium aquifers should continue providing an important water resource to the region to be used in combination with surface water to help satisfy the regional water demand. Water of good quality continues to be available from the aquifers and should continue in the future with prudent management of the resource. Groundwater supplies were calculated for each county and basin from various sources and are shown in *Table 3A.1*.

For aquifers in Fort Bend, Galveston, and Harris Counties within the jurisdictions of FBSD and HGCSO the available supplies shown in *Table 3A.1* represent the regulated groundwater supplies set by the districts and not necessarily the amount of water available from the aquifer. Water User Groups that are not regulated by the subsidence districts such as irrigators and small domestic well users would be allowed to withdraw water in excess of these supplies in order to meet their demands. The certified groundwater management plan for the Bluebonnet Groundwater Conservation District was used as a basis for estimating groundwater availability in Austin and Walker Counties. The certified groundwater management plan for the Lone star Groundwater Conservation District was used as a basis for determining or estimating groundwater availability in Montgomery County.

3.3 Identification of Surface Water Sources

As stated in *Chapter 1*, surface water sources in Region H consist of reservoir storage, ROR supply from the three rivers (the Trinity, San Jacinto, and Brazos), and four coastal basins (the Neches-Trinity, Trinity-San Jacinto, San Jacinto-Brazos, and Brazos-Colorado). The water supply information presented is based on the Texas Commission on Environmental Quality (TCEQ) Water Availability Models (WAM), updated specifically for the Regional Water Plan. A map showing major surface water sources that serve Region H is included as Figure 3-8.

3.3.1 Available Surface Water

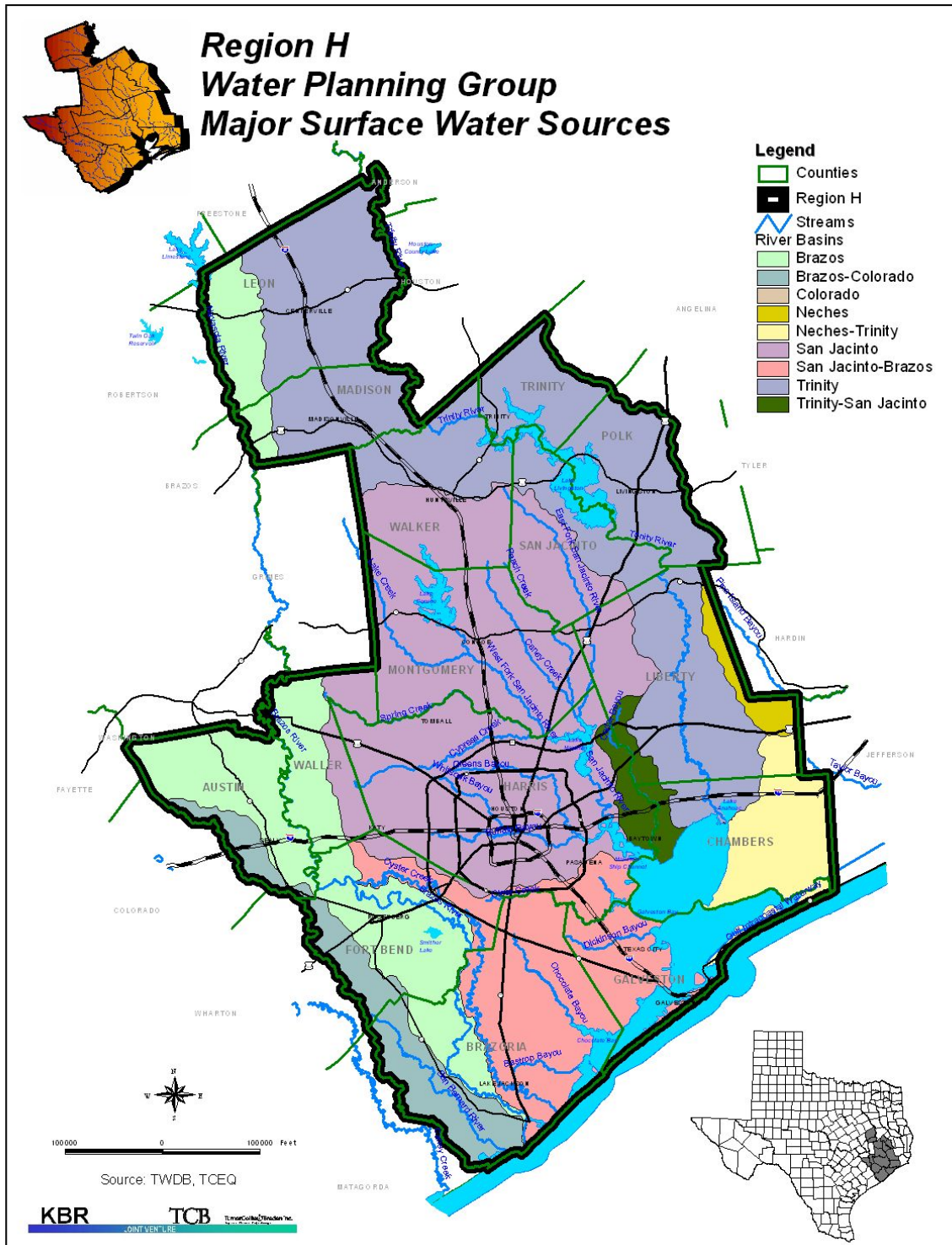
Surface water availability was estimated using the TCEQ WAM for the river basins within Region H. The WAMs use the Water Rights Analysis Package (WRAP), developed at Texas A&M University, to simulate diversions under current and future conditions using historical rainfall and evaporation data (the model does not increase diversion amounts over time, as will actually occur). Instead, the model simulates one set of monthly diversion targets attempted annually against a historical inflow dataset, which is typically 50 years long and

varies each year. The drought of record (DOR) for most of Texas occurred in the 1950s and is reflected in the historic dataset for each basin. Water diversions are modeled according to the parameters of each particular water right and taken in priority order, so that the most senior water rights are satisfied before junior rights are allowed to divert water. Output files are compared by reviewing the statistical frequency of meeting diversion amounts or target instream flow levels. The reliable yield of a water right is the least amount of water diverted among all of the calendar years modeled. For reservoirs, an additional step is required to determine firm yield. Water stored in reservoirs allows diversions to continue during periods of drought; however, diverting at high rates rapidly depletes storage. To find the optimal target for a reservoir, an iterative process is used, modeling the permit first at its full authorized diversion, and then at reduced target diversions until a yield is identified that is met throughout the simulation period.

There were originally eight WAM scenarios (referred to as model runs) simulated under the TCEQ program. The Guidelines for Regional Water Planning require the use of WAM Run 3, full-authorized diversion of current water rights with no return flows, when determining the supply available to the region. This is a very conservative approach, since diversions for municipal and manufacturing use typically return up to 60 percent of that water to streams as treated wastewater effluent. However, the majority of water rights do not address return flows to source streams, implying a right to full consumptive use. The Region H Planning Group adopted the Region G – Brazos G WAM which modified the Brazos River WAM Run 3 to allow for some return flows from wastewater plants in the Brazos River basin.. Further discussion of the Brazos G WAM is described in detail in *Section 3.3.1.6 Brazos River Basin*.

Table 3-4 summarizes the projected yield from surface water supply sources currently available to Region H. The total of about 2,679,000 acre-feet per year is approximately equal to the estimated total in the 2001 Regional Water Plan, but the distribution between permits has changed. The yield of several reservoirs decreased due to the projected storage loss as a result of sedimentation, but additional water rights were added as a result of the WAM modeling. The major water rights and modeling assumptions for each basin are discussed in detail below.

Figure 3-8:
Major Surface Water Sources



**Table 3-4:
Current Surface Water Supply Sources Available in Region H**

Projected Year 2060 Available Yield	
Basin/Reservoir/Run-of-River	(acre-feet/year)
Sam Rayburn Reservoir and Neches Basin Supplies ¹	60,727
Neches-Trinity Coastal Basin	21,702
Trinity Basin	
Lake Livingston/Wallisville	1,344,000
Run-of-River, Lower Basin	227,030
Trinity – San Jacinto Coastal Basin	34,232
San Jacinto River Basin	
Lake Houston	168,000
Lake Conroe	74,300
Run-of-River	55,000
San Jacinto – Brazos Coastal Basin	39,181
Brazos River Basin	
BRA/COE System ²	138,913
Run-of-River, Lower Basin	472,103
Brazos – Colorado Coastal Basin	12,019
Local Supplies (i.e. Stock ponds, etc), all basins	31,895
Total Existing Surface Water Supply Available to Serve Region H	2,679,102

¹ The total yield of Sam Rayburn Reservoir is 820,000 acre-feet/year. The value shown only includes the portion currently contracted to customers within Region H.

² This amount is based on current contracts within Region H. The total yield of the BRA/COE system is 691,717 acre-feet/year.

The TCEQ WAM models were updated to add new water rights and reflect the affects of sedimentation on reservoirs. Reservoirs reduce the velocity of the streams they impound, causing suspended soil particles to settle out. Over time, storage volume is lost due to this accumulation. Sedimentation rates were determined and applied to on-channel reservoirs to calculate the year 2000 and year 2060 storage volumes (see Table 3-5). The WAM model was then run under each storage condition. The storage capacity lost to sedimentation reduced the yield of most reservoirs in the year 2060. This change in yield was represented as a linear decline over time in the summary tables.

**Table 3-5:
Water Supply Reservoir Capacities**

Reservoir	Surface	Storage Capacity		
	Elev.	Original	2000	2060
	feet (msl)	ac-ft	ac-ft	ac-ft
Trinity Basin				
Livingston	131.0	1,741,867	1,738,326	1,717,083
Anahuac	5.0	35,300	25,781	25,691
San Jacinto Basin				
Houston	44.5	133,990	131,547	106,409
Conroe	201.0	416,228	414,143	377,567
Brazos Basin – BRA/COE System				
Aquilla	537.5	52,400	43,304	11,398
Alan Henry	2220.0	115,937	115,689	113,519
Belton	594.0	457,600	431,035	417,208
Georgetown	791.0	37,100	36,981	36,620
Granger	504.0	82,000	52,525	22,597
Stillhouse Hollow	622.0	235,700	224,279	202,868
Granbury	693.0	153,500	132,153	92,129
Possum Kingdom	987.0	504,100	552,013	509,944
Whitney	533.0	627,100	549,788	439,678
Limestone	363.0	217,494	211,229	172,476
Proctor	1162.0	59,400	54,702	47,104
Somerville	238.0	160,100	154,322	145,442

The total supply available from each source available to Region H is included in *Table 3A.1, Current Water Sources*, in *Appendix 3A*. In general, *Table 3A.1* indicates the maximum amount of water supply that could be obtained during DOR conditions from each supply source. This information was compiled from existing contracts and water rights in Region H, the updated WAM for surface water supplies, and groundwater studies addressed in *Section 3.2* of this chapter. Not all of the sources listed in *Table 3A.1* are exclusively available to Region H. Reservoirs located in the upper portions of the Brazos, Trinity, and Neches basins are shown with their firm yield, but the portion of that yield available within Region H is limited to the contracted amounts.

3.3.1.1 Neches-Trinity Coastal Basin

Surface supplies in the Neches-Trinity Coastal River Basin were modeled using the TCEQ WAM Run 3 model. Of the water right permits totaling 69,554 acre-feet per year from the Neches-Trinity coastal basin, 37,269 acre-feet per year were reliable during the DOR. Approximately one-third of this firm total is the U.S. Fish and Wildlife Service water right for the Anahuac National Wildlife Refuge. Water rights yielding over 500 acre-feet per year for consumptive uses (all for irrigation) are listed in *Table 3A.1* and total 21,701 acre-feet per year. This is almost twice the basin yield estimated in the 2001 Regional Water Plan (10,971 acre-feet per year). The WRAP input file for this model is included in *Appendix 3B*.

3.3.1.2 Trinity River Basin

The Trinity River Basin contains 32 major reservoirs, including two Region H sources, Lake Livingston/Wallisville and Lake Anahuac. The permitted yield of Lake Livingston was diminished using WAM Run 3, but showed a firm yield in excess of the permit amount in the TCEQ WAM Run 1 (full use with expected return flows). The Region C Water Planning Group was contacted to discuss the amount of water reuse expected to occur within the upper basin during the planning period. While Region C is pursuing multiple reuse strategies, it is anticipated that sufficient return flows would exist throughout the planning period to make Lake Livingston's permitted yield firm. The WRAP input file for this model is included in *Appendix 3B*.

The reliability of three lower Trinity River ROR supplies came from a set of "fixed right" agreements. The agreements are between the Trinity River Authority (TRA) and the City of Houston (COH) (who jointly own the water rights for Lake Livingston) and three providers of irrigation-water. These irrigation-water providers are the Chambers-Liberty Counties Navigation District (CLCND), the American Rice Growers Co-op Association (Dayton Canal), and the Devers Canal Rice Producers Association (Devers Canal). Pursuant to the fixed right agreement CLCND, Dayton Canal, and Devers Canal are entitled to divert up to 88,820, 33,000, and 86,000 acre-feet per year, respectively. These diversions occur from the Trinity River and some tributaries of the Trinity River. Although these diversions physically take place downstream of Lake Livingston, they are senior in priority to the Lake Livingston water rights.

Approximately 27,500 acre-feet per year of the Devers Canal's 86,000 acre-feet per year is part of the Lake Livingston yield and is reflected in the plan as a contractual commitment of the TRA. Fifty-six thousand of the remaining 58,500 acre-feet per year of the Devers Canal yield was purchased by the San Jacinto River Authority (SJRA), for use in the Trinity-San Jacinto Coastal Basin.

Houston recently purchased outright the entire amount of the Dayton Canal fixed right agreement. Additionally, Houston holds another water right in the Trinity River Basin with an authorized diversion of 45,000 acre-feet per year from the Old River Tributary of the Trinity River.

In addition to the 88,820 acre-feet per year in the fixed right agreements, CLCND also owns the rights (54,127 acre-feet per year, of which 20,200 acre-feet per year is reliable) to the Turtle Bayou (Lake Anahuac) supply in the Trinity River Basin. The SJRA purchased a portion (30,000 acre-feet per year) of CLCND's fixed right in 2001.

The ownership of the Trinity River Basin supplies is summarized in Table 3-6.

**Table 3-6:
Ownership of Trinity River Basin Supplies**

Owner	Source	Permitted Amount (acre-feet/year)	Reliable Yield (acre-feet/year)
COH	Lake Livingston/Wallisville System	940,800	940,800
TRA	Lake Livingston/Wallisville System	403,200	403,200
COH	Trinity River and Big Ditch	38,000	33,000
COH	Old River Tributary	45,000	26,510
SJRA	Trinity River	86,000	86,000
CLCND	Trinity River	58,820	58,820
CLCND	Lake Anahuac	54,127	14,326
Devers Canal	Trinity River	2,500	2,500

The supply amounts shown for the Lake Livingston/Wallisville Saltwater Barrier system are the total permitted diversions for each body of water, as discussed in the paragraph above. The City of Houston has a permit to divert 902,800 acre-feet per year from Lake Livingston and 38,000 acre-feet per year from the Wallisville Saltwater Barrier. The TRA has a permit to divert 351,600 acre-feet per year from Lake Livingston and 51,600 acre-feet per year from the Wallisville Saltwater Barrier. Not all of this water would be available to Region H. Of the amount that is owned by the TRA, 16,000 acre-feet per year is committed outside of Region H. In addition, it should be noted that physical diversions are not made from the Wallisville Saltwater Barrier, but the combined yield of Lake Livingston is increased when operated in conjunction with the Wallisville Saltwater Barrier. The increase in yield is a result of the barrier precluding the need for salinity reduction releases for downstream senior water rights.

3.3.1.3 Trinity-San Jacinto Coastal Basin

The surface water supply in the Trinity-San Jacinto Coastal Basin was modeled using WAM Run 3. Water right permits totaling 44,374 acre-feet per year from the Trinity-San Jacinto Coastal Basin were analyzed using the water availability model. Of this, 35,065 acre-feet per year was found to be reliable during the DOR. Water rights yielding over 500 acre-feet per year for consumptive uses are listed in *Table 3A.1* located in *Appendix 3A*, and total 34,232 acre-feet per year. Texas Genco’s Cedar Bayou plant has a permit to divert 30,000 acre-feet per year of saline water from Cedar Bayou, which accounts for most of the firm supply. The remaining 4,232 acre-feet per year are irrigation rights. The WRAP input file for this model is included in *Appendix 3B*.

3.3.1.4 San Jacinto River Basin

The surface water supply in the San Jacinto River Basin was modeled using WAM Run 3. Water right permits totaling 346,344 acre-feet per year from the San Jacinto River Basin were analyzed using the water availability model. Of the 346,344 acre-feet per year permitted, 297,300 acre-feet per year was found to be reliable during the DOR. The Indirect Reuse Water Right 10-5809 does not appear in the model because it was issued in June 2004, but it is assumed reliable and included in *Table 3A.1 (Appendix 3A)*, bringing the basin total to 312,244 acre-feet per year. The WRAP input file for this model is included in *Appendix 3B*.

The only ROR diversion right included for the basin is the SJRA permit for 55,000 acre-feet per year. SJRA diversions are physically made from Lake Houston and are the primary source of water for the SJRA Highlands Canal System. Other reliable water rights in the basin were either for recreation or less than 500 acre-feet per year and were not included in *Table 3A.1 (Appendix 3A)*.

Lake Houston

Lake Houston remained reliable at its full permitted diversion, even when the year 2060 sedimentation condition was applied. This is due to its downstream location on the San Jacinto River and its seniority relative to other major water rights in the basin. The COH owns the entire permitted yield from Lake Houston.

Lake Conroe

The Lake Conroe yield declined from its permitted amount of 100,000 acre-feet per year to 74,300 acre-feet per year due to the WAM Run 3 condition and the year 2060 storage capacity estimate. The WAM Run 3 assumption that no return flows will be available greatly impacted the streamflows in the lower San Jacinto Basin. Lake Houston is senior to Lake Conroe, which results in Lake Conroe passing inflows when Lake Houston storage levels drop. As a result of the removal of return flows from the model, Lake Conroe passes more inflows in order to keep Lake Houston full. Also, the bathymetric survey used to determine the sedimentation rate for Lake Conroe identifies a potential discrepancy in the original volumetric capacity of Lake Conroe. This discrepancy likely resulted in a higher than actual sedimentation rate, which also reduces the yield over a 60-year period. It was recommended that a second bathymetric survey be conducted around the year 2005 to recalculate the sedimentation rate. The COH and SJRA jointly own the water right for Lake Conroe. The COH portion is to divert 66,667 acre-feet per year from Lake Conroe, with an estimated year 2060 reliable yield of 49,038 acre-feet per year. SJRA is authorized to divert 33,333 acre-feet per year from Lake Conroe, with an estimated year 2060 reliable yield of 25,262 acre-feet per year.

Gulf States Utility Company (now known as Entergy) has a contractual agreement with SJRA to divert water from Lake Conroe into Lewis Creek Reservoir. In the 2001 Region H Water Plan, this permit was represented as a separate water right with

a yield of 6,300 acre-feet per year. This has been corrected to be represented as a contract in this plan.

3.3.1.5 San Jacinto-Brazos Coastal Basin

Surface supply in the San Jacinto-Brazos Coastal Basin was modeled using Run 3. Water right permits totaling 120,919 acre-feet per year from the San Jacinto-Brazos Coastal Basin were analyzed using the water availability model. Of the 120,919 acre-feet permitted, only 33,372 acre-feet per year was found to be reliable during the DOR. Water rights yielding over 500 acre-feet per year for consumptive uses are listed in *Table 3A.1 of Appendix 3A*, and total 30,627 acre-feet per year. Texas Genco's Webster plant has a permit to divert 4,440 acre-feet per year of saline water from Clear Lake, which is not simulated in the model. The firm portion of this supply is 2,120 acre-feet per year. The WRAP input file for this model is included in the Brazos Basin WRAP input file in *Appendix 3B*.

3.3.1.6 Brazos River Basin

Surface supply in the Brazos River Basin was modeled by HDR for the Brazos G Water Planning Group. A survey of wastewater plant operators within the Brazos Basin was conducted to determine the amount of anticipated reuse during the planning period. Based on the survey results, WAM Run 3 was modified to allow 130,370 acre-feet per year (116.4 million gallons per day [mgd]) of return flows in the model. There are water right permits in the Brazos River Basin of Region H totaling 866,351 acre-feet per year. The modeled yield of these rights was 488,419 acre-feet per year. Water rights yielding over 500 acre-feet per year for consumptive uses are listed in *Table 3A.1 of Appendix 3A* and total 472,094 acre-feet per year. The WRAP input file for this model is included in *Appendix 3B*.

There was a significant reduction in expected yield from the lower Brazos Basin despite the allowance of limited return flows in the model. The Gulf Coast Water Authority holds two water rights authorizing 224,932 acre-feet per year. In the 2001 Region H Water Plan, the combined yield was estimated at 178,182 acre-feet per year. Under this model scenario, the estimated yield fell to 171,193 acre-feet per year. Similarly, the Richmond Irrigation Company water right yield fell from 40,000 to 29,920 acre-feet per year. The largest decline was seen in the Dow Chemical water right, with an authorized diversion of 305,656 acre-feet per year. The firm portion of this right was estimated as 207,729 acre-feet per year in the 2001 Region H Water Plan, and yields 148,052 acre-feet per year under this model.

Despite the yield reductions for several water rights in the basin, some firm yields increased. The estimated yield of the Chocolate Bayou Water Company rights increased from 46,982 acre-feet per year to 63,812 acre-feet per year, due to modeling of the system storage. Texas Genco's yield from Smithers Lake increased from 9,841 acre-feet per year to 34,300 acre-feet per year, also due to storage modeling. The Brazosport Water Authority water right yield increased from 15,098 acre-feet per year to 23,017 acre-feet per year.

Brazos River Authority/U.S. Army Corps of Engineers System (BRA/COE)

The Brazos River Authority stores water in a system of water supply and flood control reservoirs in the middle and upper basins. The Authority owns Alan Henry, Possum Kingdom, Granbury, and Limestone Reservoirs. The U.S. Army Corps of Engineers owns the remaining reservoirs in the system. The supply amounts included in *Appendix 3A* for these facilities were provided by the Brazos G Water Planning Group. The BRA system total yield is estimated at 691,717 acre-feet per year. The portion of this yield available to Region H is reflected in supply contracts between the BRA and customers in this region. Those contracts total 138,913 acre-feet per year.

3.3.1.7 Brazos-Colorado Coastal Basin

The Brazos-Colorado Coastal Basin contains the lower reach of the San Bernard River. The model for this basin was included in the Colorado River WAM, prepared by RJ Brandes Co. for the TCEQ. Two water rights were identified within Brazoria County, and the WAM Run 3 results for these rights are identified in this report. A year 2060 iteration was not made for this basin, because sedimentation was not anticipated in the off-channel reservoir associated with these rights. The WRAP input file for this model is included in *Appendix 3B*.

3.3.1.8 Lake Sam Rayburn

A water supply allocated from Lake Sam Rayburn in the Neches River Basin, listed in *Table 3A.1*, represents contracted amounts from the Lower Neches Valley Authority by the Trinity Bay Conservation District, the Bolivar Peninsular SUD and irrigators in Chambers and Liberty Counties. The full yield of the lake was obtained from the East Texas Water Planning Group, and the contract amounts are reflected in both regional plans.

3.3.1.9 Local Supplies

Local supplies (stock ponds, catchments, etc.) that cannot be related to reported groundwater or surface water use are currently meeting certain livestock and mining demands. The TCEQ allows a landowner to impound up to 200 acre-feet of water without obtaining a water right. Numerous local supplies are included as surface water supplies in *Appendix 3A*.

3.3.2 Surface Water Drought Susceptibility

Within this report, the surface water reservoir and ROR supplies represent firm yield and reliable quantities, respectively. However, surface water is dependent on rainfall, and future droughts cannot be expected to follow the same pattern as the DOR used in the WAM. Therefore, the river authorities and water providers in Region H maintain Drought Contingency Plans prepared under provision of the *Texas Administrative Code, Section 30, Chapter 288* for their respective shares of these supplies. These drought plans are highlighted in *Table 3-7* and tabulated in detail in *Appendix 3C*. While each water provider utilizes unique criteria to define drought stages, their drought contingency plans use a

common methodology. A first-stage trigger is used to initiate customer notification systems and voluntary use reductions. A second-stage trigger is used to initiate mandatory use reductions. Finally, a third-stage trigger is used to initiate additional use reductions and/or the suspension of service to some customers.

3.3.3 Surface Water Conveyance Systems

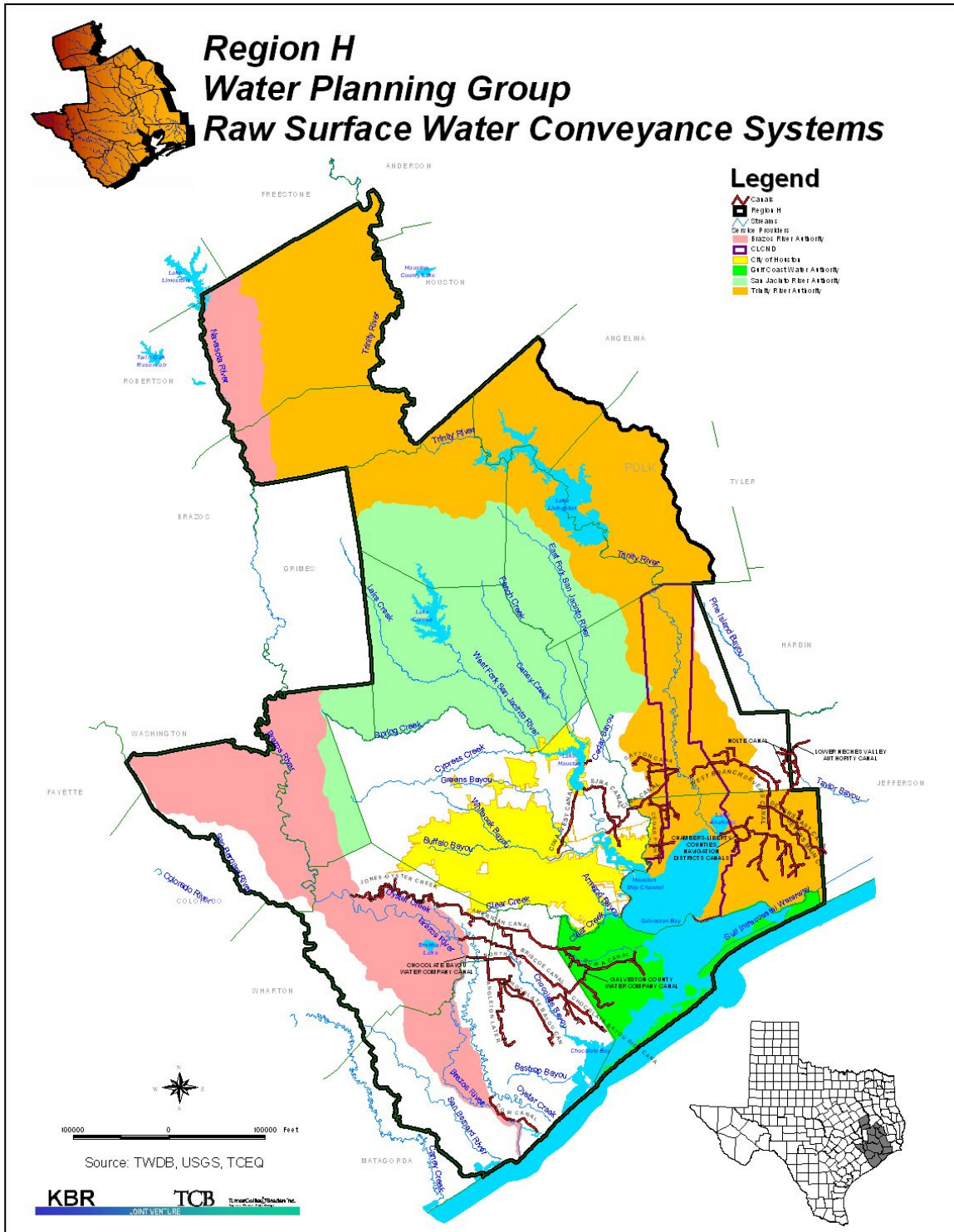
Region H contains a number of raw surface water conveyance systems (pipelines, canals, and pump stations). The conveyance systems lie primarily in the coastal river basins in the southern counties of Region H. The main canal systems belong to the COH, CWA, Gulf Coast Water Authority (GCWA), TRA, Lower Neches Valley Authority (LNVA), Chocolate Bayou Water Company, SJRA, CLCND, and Dow Chemical. The information in this section was gathered from each of the entities listed above and the Trans-Texas Water Program Phase I Report for the Southeast Area. These systems are shown in Figure 3-9.

The CWA network consists of a main conveyance canal system and a pipeline distribution system. The conveyance system includes the Trinity River pump station, the main canal, the Lynchburg Reservoir, the Cedar Point lateral, the Lake Houston pump station, and the west canal. The Trinity River pump station near Liberty has an existing capacity of 880 mgd (700 mgd firm plus standby) and an ultimate design capacity of 1,400 mgd. The main canal runs westerly from the Trinity River pump station about 22 miles to the Lynchburg Reservoir (north of the Houston Ship Channel). The total capacity of the canal is approximately 1,300 mgd from the Trinity River Pump Station to the Cedar Point lateral. Downstream of the Cedar Point lateral, the canal has a capacity of 1,100 mgd. The Lynchburg Reservoir has an impoundment capacity of 4,600 acre-feet. The Cedar Point lateral, with a design capacity of 230 mgd, is located about 8 miles southwest of the Trinity River pump station and diverts water from the main canal southward. The Lake Houston pump station diverts water from Lake Houston into the CWA west canal, which travels southwesterly until it terminates at the COH East Water Purification Plant. The CWA distribution system consists of pressure pipelines that start at the Lynchburg Reservoir with the Lynchburg pump station and extend southwest about 10 miles to the Bayport Industrial Complex and eastward along State Highway (SH) 225 conveying raw water to industrial users.

**Table 3-7:
Typical Drought Triggers for Region H Supplies**

Water Source/ Established By	Drought Type	Trigger Condition and Duration
Lake Livingston – Wallisville System/TRA	Mild	Lake Livingston elevation is <126.50 feet at USGS gage, condition lasts 1 day
	Moderate	Lake Livingston elevation is <124.00 feet at USGS gage, condition lasts 1 day
	Severe	Lake Livingston elevation is <121.40 feet at USGS gage, condition lasts 1 day
Lake Conroe/SJRA	Mild	Elevation <194 feet (70% of storage capacity), condition lasts 1 day
	Moderate	Elevation <190 feet (55% of storage capacity), condition lasts 1 day
	Severe	Elevation <185 feet (40% of storage capacity), condition lasts one day
Houston System Reservoirs/ City of Houston	Mild	Combined storage (Lakes Livingston, Conroe, and Houston) is less than 24 months surface water supply, condition lasts 10 consecutive days
	Serious	Combined storage (Lakes Livingston, Conroe and Houston) is less than 18 months surface water supply, condition lasts 10 consecutive days
	Severe	Combined storage (Lakes Livingston, Conroe, and Houston) is less than 12 months surface water supply, condition lasts 10 consecutive days
Brazos River at Richmond/GCWA	Mild	12.19 feet or 1700 cfs, condition lasts 1 day
	Moderate	11.93 feet or 1500 cfs, condition lasts 1 day
	Watch	11.65 feet or 1300 cfs, condition lasts 1 day
	Warning	11.23 feet or 1000 cfs, condition lasts 1 day
BRA System Reservoirs/BRA	Watch	Storage <= 20% drought reoccurrence frequency level and could fall below 10% drought reoccurrence frequency level within 12 months
	Warning	Storage <= 10% drought reoccurrence frequency level and could fall below 5% drought reoccurrence frequency level within 12 months
	Emergency	Storage <= 5% drought reoccurrence frequency level

Figure 3-9:
Raw Surface Water Conveyance Systems



The GCWA system consists of three main canals that deliver water from the Brazos River to Fort Bend, Brazoria, and Galveston Counties: the American Canal, the Briscoe Canal, and the Galveston Canal System. The American Canal runs parallel to SH 6 southeasterly from the Brazos River lift station (the Shannon Plant, which is 12 miles north of Rosenberg) to Alvin, Texas. The Briscoe Canal runs southeasterly from the Brazos River pump station (the Briscoe Plant, which is 6 miles west of Arcola) to Alvin and then to an industrial complex in southern Brazoria County. The American Canal is connected to the Briscoe Canal by “Lateral 10” just west of Manvel. The Galveston Canal System extends from the old Briscoe system southeast of Alvin to the GCWA Reservoir (four miles east of Dickinson). The Galveston Canal System connects to the American Canal six miles east of Alvin. The Gulf Coast Water Authority has three pump stations, the Shannon Plant with a total capacity of 347 mgd, the Briscoe Plant with a total capacity of 302.4 mgd, and the American Canal’s second lift station located in Sugar Land with a total capacity of 225 mgd.

The Dayton Canal is a small system that serves Liberty County. The canal, which diverts from the Trinity River, extends about 20 miles west of the river and has an estimated capacity of 90 mgd.

The Devers Canal System currently delivers irrigation water easterly from the Trinity River to customers in Liberty and Chambers Counties. The main canal system is 81 miles with 125 miles of laterals. Due to the flat grade of the main canal, the flow can be reversed to flow westerly. The system contains two pump stations. The first one on the Devers main canal at the Trinity River has a total rated capacity of 295 mgd, and the second pump station (near SH 563) has a total capacity of 274 mgd.

The LNVA system diverts water from the Neches River and Pine Island Bayou and delivers it to customers in Jefferson County, farmers in Chambers and Liberty Counties, and to the Bolivar SUD in Galveston County. The LNVA canal consists of two main canals, the Neches Main and the BI Main. After the junction of the two main canals, the Neches Main travels southwesterly until the Nolte Canal branches off traveling westward into Liberty County. At this point the Neches Main turns and extends southward into Chambers County. The Nolte Canal and the end of the Neches Main are the only sections of the LNVA canal system that extend into Region H. The Nolte Canal is divided into two portions by a check structure. The capacity of the Nolte Canal upstream of the check is 130 mgd and 36 mgd downstream from the check structure.

The Chocolate Bayou Water Company has a distribution system that can be divided into two sections. The Juliff section, also known as the old South Texas Water system, transports water from the Juliff pump station on the Brazos River near the Fort Bend-Brazoria County border, and the Chocolate Bayou Canal section, which transports water from Chocolate Bayou near Liverpool. The Juliff section has two main canals (the North Canal and the Main Canal) and the Angleton Lateral. This section provides irrigation water to rice farmers and some industrial water to Brazoria County. The Chocolate Bayou Canal section has its main pump station on Chocolate Bayou, but there are additional pump stations on Mustang Bayou and Halls Bayou as well. This section also provides irrigation and industrial water to Brazoria County.

SJRA provides raw surface water from a point at the Lake Houston dam through its canal system and SJRA's Highlands Reservoir to a point just north of the Houston Ship Channel, providing service to the industrial customers in eastern Harris County. SJRA also contracts with the Coastal Water Authority (CWA) to convey its Trinity Basin water supplies through the CWA Main Canal, and from there to their Highlands System.

The CLCND canal system diverts water from the Trinity River just south of Lake Anahuac. The canal travels easterly and branches to the north and south along the length of the main canal to serve the City of Anahuac and irrigators in Chambers County.

The Dow Chemical Company diverts water from the Brazos River into the Harris and Brazoria Reservoirs in Brazoria County. From Harris Reservoir, water is released into Oyster Creek and rediverted into a canal near Lake Jackson. From the Brazoria Reservoir, water is released into Buffalo Camp Bayou, which joins the Dow canal below the Oyster Creek diversion pump station. The canal travels parallel to the Brazos River and supplies the Brazosport Area Water Authority Water Treatment Plant before entering the Dow complex just north of Freeport. The canal continues east around Freeport to serve the Dow southern facility.

3.3.4 Previously Studied Potential Reservoir Sites

In the City and Basin Master Plans within Region H, twenty-four potential reservoir sites have been identified. Of these, four have been identified in the State and Regional Water Plans as reservoir sites of unique value—Allens Creek in the Brazos Basin, Austin County; Little River in the Brazos Basin, Milam County; Bedias in the Trinity Basin, Madison County; and Tehuacana in the Trinity Basin, Freestone County. Construction of the first three reservoirs was recommended in the Regional Water Plans. From information provided in existing studies and reports, a summary table listing expected yields, costs, and a brief discussion of potential issues of concern regarding each potential reservoir is included in *Appendix 3D*.

The potential reservoir sites for Region H were reassessed as potential water management strategies for this update to the water plan. That discussion is presented in *Chapter 4*. Also, the sites were again considered for recommendation as reservoir sites of unique value. That discussion is presented in *Chapter 8*.

3.3.5 Legal and Regulatory Factors

A number of legal (institutional) and regulatory factors affect water planning, development, and usage within the Region H area. The most notable of these factors are surface water rights, groundwater conservation districts, interbasin transfer rules, wastewater return flow impacts, and environmental flow requirements.

All of the water included in the analysis of surface water supplies for Region H is obtained under water rights issued through the TCEQ and its predecessor agencies. The larger wholesale water providers hold a substantial portion of the rights available to the region, and these large providers contract to supply water obtained under those rights to various WUGs.

Five groundwater conservation districts exist within the Region H area. These districts are the HGCSO, FBSD, Bluebonnet Groundwater Conservation District (includes Austin, Walker, and Waller Counties), Lone Star Groundwater Conservation District (Montgomery County) and Mid-East Texas Groundwater Conservation District (includes Leon and Madison Counties). Each district enacts and enforces groundwater regulations within their respective counties. The specific rules regulating the use of groundwater use were described in the previous section, *Subsidence Effects*. The Harris-Galveston and Fort Bend districts have adopted regulatory plans that limit the withdrawal of groundwater within their respective counties.

The Brown-Lewis Bill (formally Senate Bill 1, 75th Legislature) included restrictions on the interbasin transfer of water. These rules mandate that water supplies obtained by a receiving basin become junior to all other rights in existence within the originating basin of the transfer. This rule applies to all future permits associated with interbasin transfers. As illustrated within this report, a significant quantity of water currently supplied within Region H occurs via interbasin transfers. A portion of the water delivered by all of the larger water providers occurs through some type of interbasin transfer. The most significant of these are the COH and SJRA transfers of Trinity River water into the San Jacinto watershed and the BRA and GCWA transfers of Brazos River water into the San Jacinto-Brazos Coastal Basin. It is anticipated that new interbasin transfers will be needed to support growth throughout Region H, particularly to the San Jacinto and San Jacinto-Brazos Basins where the largest population growth is occurring. Current limitations on interbasin transfers will affect the development of future water resource management strategies.

In the 77th Texas Legislature, the Water Code was amended to remove an obstacle to long-term planning. Under the previous law, any water right that was unused for a period of ten years could be cancelled by the TCEQ, making that water available for diversion under other water rights permits. This is contrary to the state and regional water planning processes, which project demands 50 years in advance and recommend projects to meet demands 30 years in advance. The amendment to the Water Code exempts certain water rights from cancellation for non-use, including permits obtained as a result of the construction of a reservoir in whole or in part by the permit holder, permits for reservoirs of 50,000 acre-feet or larger, and permits obtained to meet demonstrated long-term water supply or electric generation needs.

Wastewater reuse and reclamation is a water management strategy that is growing in usage within the Texas water industry. Wastewater reuse is the reuse of wastewater prior to its discharge into a receiving stream of the state. These reused quantities can become supply for irrigation, manufacturing, mining, steam-electric power and limited municipal purposes (landscaping, etc.). Wastewater reclamation, however, can affect the reliability of existing surface water rights. In particular, within Region H, one of the greatest potential areas of reuse is within Harris and Montgomery Counties upstream of Lake Houston. Reuse within Region C in the Trinity Basin would impact the yield of Lake Livingston. Thus significant reuse of these flows may affect the water rights of SJRA, TRA, and COH. Indirect reuse permits are increasingly being requested within the state, allowing the use of the bed and banks of the receiving stream to carry treated effluent to a downstream diversion point. Unlike direct reuse, this practice is considered a separate diversion and requires a separate

water right permit. These permits typically allow the redirection of a percentage of the discharged volume, with the difference being allocated to meet carriage losses and instream flow requirements. The amount required to be left instream is determined on a site-specific basis by TCEQ.

3.3.6 Environmental Uses and Requirements

Water right permits for environmental use and enhancement may be granted by TCEQ, although there is no use category within the Water Code for meeting environmental needs. These water rights are typically categorized as Recreational or Other. Within Region H, there are fewer than 20 permits for the diversion or impoundment of water for the purposes of wetland habitat creation/maintenance, wetland mitigation, or wildlife conservation. The larger of these permits are listed in Table 3-8. Since 1985, environmental flow requirements have been included as conditions within new and amended water rights. These requirements may include a specified minimum instream flow or gauge height threshold for diversions under the permit, or specify a percentage of the diverted amount that must be returned to the source stream. The establishment of these permit conditions requires supporting data on environmental needs of rivers, streams, bays, and estuaries for wetlands habitat. To increase this body of knowledge, the Texas Instream Flow Program was initiated in 2003 as a joint effort between TPWD, TCEQ, and TWDB. A series of studies are funded and underway, and the results will be incorporated in future water rights permitting and regional water planning.

**Table 3-8:
Major Environmental Water Rights in Region H**

Owner	Stream	Use	Diversion (acre-feet/year)
U.S. Anahuac Wildlife Refuge	Oyster Bayou	Anahuac NWR* – wetland habitat	21,000
Texas Parks & Wildlife Department	Carpenters Bayou	Sheldon WMA** – wetland habitat	2,688
U.S. Fish and Wildlife Service	Bastrop Bayou Austin Bayou	Brazoria NWR – fish & wildlife conservation	2,527
U.S. Fish and Wildlife Service	Cedar Lake Creek	San Bernard NWR – wetland habitat	1,086
U.S. Fish and Wildlife Service	Big Slough	Brazoria NWR – fish & wildlife conservation	1,080

*NWR is National Wildlife Refuge

**WMA is Wildlife Management Area

A new provision under the Texas Water Code establishes the Texas Water Trust within the Texas Water Bank. Existing water rights can be placed in the Texas Water Trust to be

dedicated to environmental needs, including instream flows, water quality, fish and wildlife habitat, or bay and estuary inflows. While no water rights from Region H have yet been placed in the Texas Water Trust, it can be anticipated that it will figure in further efforts to address both the technical and institutional issues associated with environmental water rights within Region H.

3.3.6.1 Bay and Estuary Inflows

Estuaries are coastal waters where inflowing stream or river water mixes with and measurably dilutes sea water. The Brazos River has a very small estuary, but Galveston Bay is one of the largest and richest estuary systems in the state. Tides along the Region H portion of the Texas Gulf Coast are small (typical ranging up to 2 feet), but their influence is felt far inland due to the flat topography of the coastal plain. Galveston Bay averages a 7-foot tidal depth, so freshwater inflows are important in balancing the tidal intrusion of seawater into the estuary habitat.

The Region H Water Planning Group requested input from the Galveston Bay Freshwater Inflow Group (GBFIG) to address this resource need. GBFIG was established in December 1996 as an ad hoc technical work group. GBFIG includes representatives of major stakeholders in the use of Galveston Bay and its tributaries including all those groups specifically itemized in Sec. 11.1491 of the Texas Water Code for “estuary advisory councils.” Its efforts have been endorsed, and staff participation has been authorized by TWDB, TCEQ, TPWD, and the General Land Office (GLO). GBFIG coordinates with and reports its findings to both the Galveston Bay Estuary Program and RHWPG.

The work of GBFIG builds upon the State Bay and Estuary Studies authorized by the Legislature in 1985 (HB-2) and amended in 1987 (SB-683). On December 31, 1994, *Freshwater Inflows to Texas Bays and Estuaries: Ecological Relationships and Methods for Determination of Needs* was published jointly by TWDB and TPWD. This document details the methodology to be applied in each of seven major estuarine systems. Several draft documents providing historical inflow data (1941-1990) and application of the State’s methodology to Galveston Bay followed. In December 1998, TPWD issued a final *Freshwater Inflow Recommendation by Texas Parks and Wildlife Department for the Trinity-San Jacinto Estuary* (hereafter cited as TPWD 1998).

TPWD 1998 presented output from the State’s optimization model relating freshwater inflows to biological productivity. Based on that analysis of monthly inflow data, several points on a performance curve were identified, ranging from Max Q, the maximum quantity of freshwater falling within the range of analysis, to Min Q, the minimum modeled quantity of freshwater inflow capable of maintaining bay and estuary fishery harvest. The Galveston Bay system receives average annual inflows of about 10 million acre-feet per year (maf/yr), and median twelve-monthly inflows of just over 7 maf/yr. Because of the uncertainties inherent in analyzing or managing natural processes, TPWD recommended the point of “maximum harvest” (Max H), or a flow of 5.2 maf/yr, as the target inflow for the Galveston Bay system.

Using the data developed by the State, special studies of Galveston Bay freshwater inflows have been performed in conjunction with regional water planning efforts. In April 1998, Brown & Root completed a *Galveston Bay Freshwater Inflow Study* under the Trans-Texas Water Program. Additional modeling by Brown & Root has been performed to address specific analytic needs of GBFIG. The TCEQ WAM program has improved the statistical data and model availability for Galveston Bay. Models of the effects of the Regional Water Plans on freshwater inflows were run, and the results are discussed in *Chapter 4* of this report.

Based on information from state and regional studies, GBFIG set about relating its consideration of freshwater inflow needs to the planning task of Region H. GBFIG developed a recommendation that relates target flows under a range of conditions to target frequencies as shown in Table 3-9, which generally are less frequent than historical frequency of occurrence. GBFIG specifically noted that development of management strategies for freshwater inflows requires the consideration of quantity, quality, seasonality (monthly flows), and location of inflows and that its own analytic efforts would continue. It also noted that flows available to meet environmental water needs included total flows to the system and, as a result, include some sources outside of Region H. The GBFIG recommendation was accepted for incorporation into the Regional Water Plan in March 2000.

**Table 3-9:
Environmental Water Needs for Galveston Bay**

Inflow Scenario	Quantity Needed (million acre- feet/year)	Historical Frequency	Target Minimum Frequency
Max H	5.2	66%	50%
Min Q	4.2	70%	60%
Min Q-Sal	2.5	82%	75%
Min Historic	1.8	98%	90%

Scenario Descriptions:

Max H: Modeled inflows recommended for maximum bay and estuary fisheries harvest by TPWD.

Min Q: Minimum modeled inflow recommended to maintain the bay and estuary fisheries harvest.

Min Q-Sal: Estimated minimum acceptable inflow recommended to maintain the salinity needed for bay and estuary fisheries viability.

Min Historic: Minimum annual inflow calculated for Galveston Bay over the period of record (1941-1990).

Notes: The health and productivity of Galveston Bay must consider the quantity, quality, seasonality (monthly inflows), and location of inflows. It is anticipated that the inflow needs projections will continue to be refined over time. The use of improved data focusing on the fisheries production solely from the Galveston Bay system is one example of an anticipated means of refinement.

3.3.6.2 Water Quality

The 15th Edition (2000) of the *State of Texas Water Quality Inventory Report* by the Texas Natural Resource Conservation Commission (now the TCEQ) addresses the

streams within all Texas river basins by segment. Each segment is described and classified, the designated water uses are identified, and the water quality is determined. This report was reviewed for the river segments in Region H to identify their uses and any existing conditions or concerns. Region H is fortunate not to have naturally occurring chlorides or minerals affecting surface water quality as in some regions, but the affects of development within the watersheds are reflected in the Inventory Report. Some streams and bayous, predominantly in the lower San Jacinto Basin and the San Jacinto-Brazos Coastal Basin, were found to be non-supportive of contact recreation due to bacterial indicators of concern due to elevated nutrient levels. This condition is typically the result of wastewater discharges and urban watershed runoff. Basin maps from the *Water Quality Inventory Report* are shown in *Appendix 3E*. A search of the TCEQ Water Rights Database revealed two water rights specifically designated for the improvement of instream water quality (see Table 3-10). The larger of these is used to maintain the level of Lake Jackson in Brazoria County.

**Table 3-10:
Water Quality Rights in Region H**

Owner	Stream	Use	Diversion (acre-feet/year)
Dow Chemical Co.	Brazos River	Stream Quality Control	16,000
Cove Creek Corp.	Cove Creek	Water Quality – Flush sewage effluent	967

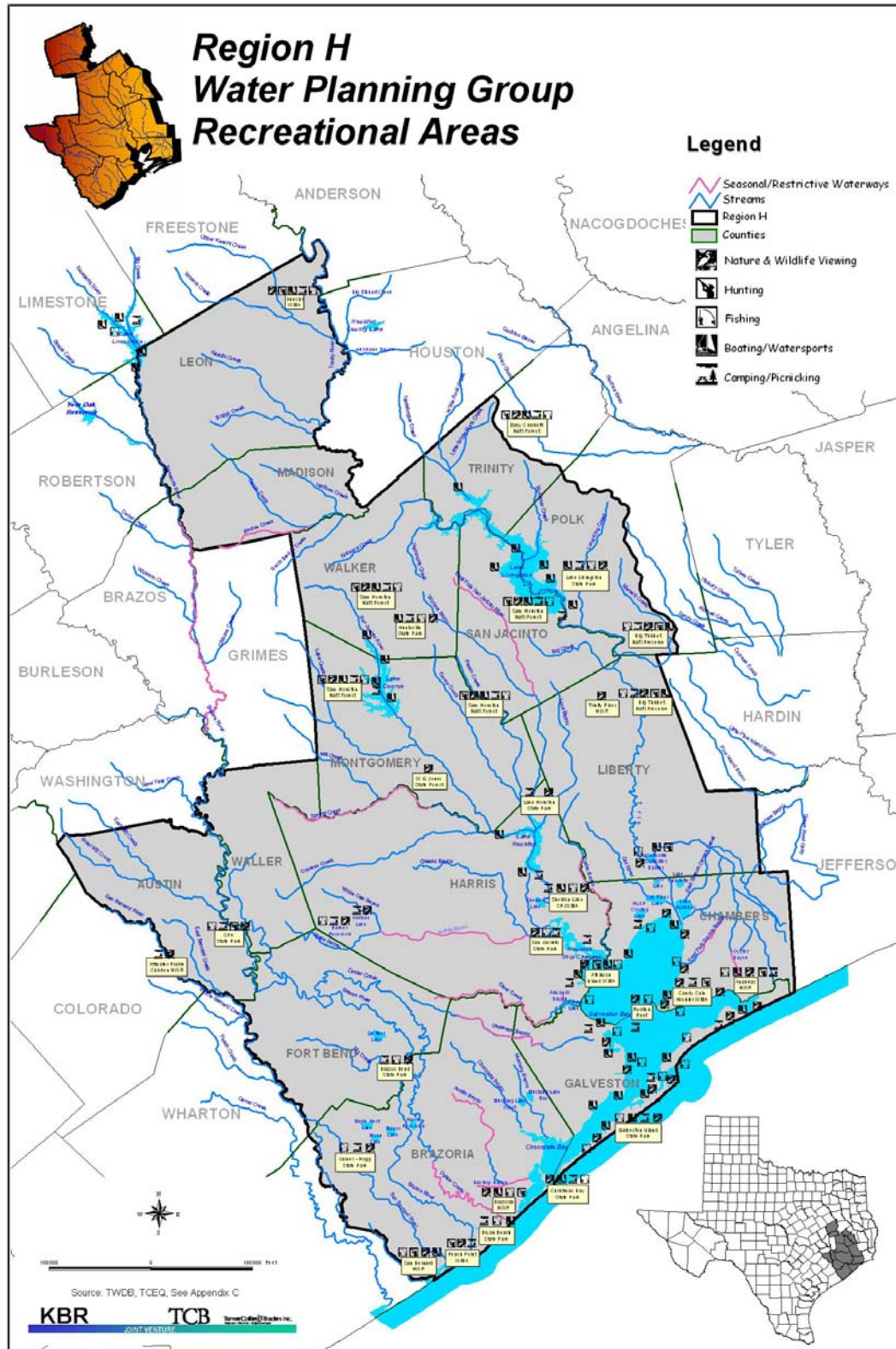
As with the Galveston Bay estuary, instream salinity is a concern in the flat lower reaches of the Trinity, San Jacinto, and Brazos Rivers. The tidal salt wedge migrates upstream during the drier summer months, threatening the intakes of water right holders. This situation has been addressed on the Trinity River by the construction of the Wallisville Saltwater Barrier, and the Lake Houston dam protects the intake points for the COH and SJRA. The effects of the salt wedge on Brazos River water rights are discussed in *Chapter 4* of this report.

The Texas Parks & Wildlife Department conducted an *Analysis of Texas Waterways: A Report on the Physical Characteristics on Rivers, Streams, and Bayous in Texas*. This 1996 report identifies the seasonal and restrictive waterways:

“those sections of rivers, streams, and bayous... which have been found to contain an insufficient flow of water for recreational use under normal conditions, or for various reasons could not be classified as a major waterway, and would be restricted to seasonal usage”

Figure 3-10 depicts the seasonal and restrictive waterways of Region H.

Figure 3-10: Seasonal and Restrictive Waterways in Region H



3.3.6.3 Unique River and Stream Segments

RHWPG identified six stream segments of unique ecological value in the 2001 Region H Water Plan. These are Armand Bayou in Harris County; Bastrop Bayou and Cedar Lake Creek in Brazoria County; Big Creek in Fort Bend County; another Big Creek in San Jacinto County; and Menard Creek in Liberty, Hardin, and Polk Counties. Several of these streams are used for irrigation and/or recreational supplies, but these water rights were not included in the total Region H supply due to size or reliability. A full discussion of unique stream segments is made in *Chapter 8*.

3.3.7 Navigational Uses

The Texas Natural Resources Code states that if a water body maintains an average width of 30 feet, it is considered navigable. The Texas Department of Transportation, the U.S. Army Corps of Engineers, and several port authorities share responsibility for maintaining the major navigable waterways within the region. These include the Gulf Intracoastal Waterway, the Houston Ship Channel, and the Lower Trinity River.

The Gulf Intracoastal Waterway is a man-made canal paralleling the Gulf Coast. In Texas, it is 433 miles long, and within Region H it crosses Chambers, Galveston, and Brazoria Counties, serving the Ports of Galveston and Freeport. The system is over 50-years old and the U.S. Army Corps of Engineers maintains the canals through a program of scheduled dredging. The flow in the waterway is brackish and not used for water supply.

The Houston Ship Channel is a deep-draft channel connecting ocean-going vessels with the Port of Houston and industries located along Buffalo Bayou. It begins at the mouth of Galveston Bay and continues north past the Barbours Cut Terminal and Bayport Industrial Complex, into the San Jacinto River and Buffalo Bayou, ending at the Port of Houston Turning Basin. Ship channels serving the Port of Galveston and the Port of Texas City branch off from the main channel on the northwestern side of Galveston Island, and the system connects with the Gulf Intracoastal Waterway at that point as well. The respective port authorities and the U.S. Army Corps of Engineers maintain the ship channels at a depth of 45 feet to serve deep-draft vessels. Although the entire length of the Ship Channel is tidally influenced, there is some concern that the deep dredging may influence the salinity of the shallow Galveston Bay estuary, which averages 7 feet deep, particularly during drought periods.

The Lower Trinity River serves the shallow (6-foot draft) cargo Port of Liberty, Texas. Water depth and freshwater quality is maintained in the Lower Trinity River by the Wallisville Saltwater Barrier, which includes a lock system for navigation. Barge traffic connects from the Port of Liberty to the Intracoastal Waterway by traversing a dredged canal along the eastern coast of Trinity Bay. This canal connects to the Houston Ship Channel west of Smith Point.

Numerous recreational ports serve the region. The Texas Department of Transportation recognizes the Port of Anahuac on the Trinity Bay and the Port of Sweeny on the San Bernard River, although there are many others. These ports are located in tidal areas, and do not require freshwater flows to maintain navigability.

3.3.8 Recreational Uses

Water-based recreational uses in Region H include activities that are directly dependent upon the region’s rivers, streams, reservoirs, and bays, such as swimming, boating, fishing, and paddle sports, as well as those enhanced by proximity to water sources such as wildlife viewing, camping and hunting, and eco-tourism. There are also economic activities associated with water-based recreation such as marinas, tourist accommodation and services, and other recreation-based businesses. Generally, communities developed adjacent to or near accessible water bodies contribute to an increased tax base from which economic benefits can accrue. Positive local tax base impacts in rural communities of Region H have been and can be significant. Therefore, reservoir development in these areas has been viewed as an economic benefit for these regions. Recreational water needs and requirements have two distinct components – physical and economic.

The physical component addresses the amount (volume) of water needed to perform various recreational activities. This is strictly a function of the geometry of whatever body of water is being considered and the type of activity that is being investigated.

In order to provide for this need, some stakeholders in water-related recreational activities apply for permits from TCEQ that allow them to divert and impound water in man-made lakes and ponds dedicated to recreational purposes. A search of the TCEQ Water Rights Database returned 160 records for recreation water rights with stated total diversion of about 9,200 acre-feet per year. Five of these rights account for 6,572 acre-feet per year in authorized diversions as shown in Table 3-11.

**Table 3-11:
Major Recreational Water Rights in Region H**

Owner	Stream	Diversion (acre-feet/year)
Brazos River Club	Brazos River	3,000
Indigo Lake Estates	Log Gully	1,164
C E Zwahr ET AL	Austin Bayou	1,003
George W Maxwell	Cow Island	805
The Woodlands Corporation	Bear Branch	600

The majority of the region’s freshwater recreation occurs not on dedicated recreational lakes, but on water supply reservoirs. The region’s water supply reservoirs provide a broad range of recreational opportunities but were created to meet the region’s consumptive water demands. While recreation is permitted on most of the region’s water supply reservoirs, there are no dedicated recreational water rights protecting volumes for recreational purposes on these reservoirs. Three water supply reservoirs in Region H provide a significant portion of the freshwater-related recreational activities in the region—Lake Livingston, Lake Conroe, and Lake Houston, in decreasing degrees.

The economic importance of water-based recreational businesses is illustrated in recent studies that indicate water-related recreational activities account for a significant portion of the Texas economy. In 1996, Texas ranked second in the United States in angler expenditures at roughly \$2.9 billion, providing more than 80,000 jobs. In the same year, there were an estimated 2.6 million anglers in Texas, with 2.1 million classified as primarily freshwater anglers. Furthermore, one study estimates that, in 1997, Texas ranked fifth in the United States in boat ownership with about \$302 million in retail boat sales. The Texas Parks & Wildlife Department reported in February of 2000 that 617,864 boats are registered in the state, 98 percent of which are used as pleasure craft. Counties in Region H account for nearly one-quarter of these (134,289) and 99 percent of these are registered as pleasure craft. In Texas, the 1991 retail sales for migratory bird hunting was \$262,600,000, and the 1991 retail sales for migratory waterfowl hunting was \$48,900,000. The 1991 retail sales for non-consumptive bird use was \$155,300,000; the 1991 non-consumptive waterfowl use in Texas was \$103,600,000. Such statistics demonstrate an economic-driven recreational need for water in Texas.

While there is a direct relationship between lake levels and these industries, there is no statistical data available to quantify that relationship. Although anecdotal information suggests negative impacts will accrue to lakeside communities when reservoir levels decrease, there is no economic data available which would allow a comparison to the economic impacts of not meeting municipal, manufacturing and/or irrigation water demands. When considering the impacts of lake levels, one might consider (1) water levels required to operate boat ramps and docks, (2) water levels or depths required to support water recreational activities (boating and fishing), and (3) water levels required to support resident and migratory wildlife. Also important to consider is the acceptable duration of a given condition. Lake levels will decline during droughts, but recover during average-to-wet years. Resident wildlife species will be directly affected by the drought conditions. Migratory species would be indirectly affected, because they would be able to adjust their routes to find the best habitats in a particular year.

All state parks and forests, national parks and forests, wildlife refuges, and wildlife management facilities were identified in order to consolidate a listing of recreational resources in Region H. Every facility was researched to determine if it provided facilities for camping and picnicking, nature and wildlife viewing, hunting, fishing, and boating and other water sports. Sources include various websites and publications from the Texas Parks & Wildlife Department, National Park Service, USDA Forest Service, U.S. Fish and Wildlife Service, National Wildlife Refuge System, Galveston Bay National Estuary Program, U.S. Army Corps of Engineers, U.S. Historical Society, Great Outdoor Recreation Pages, Recreation.Gov, *1998-1999 Texas Almanac*, Texas road atlases, and various county and river authority websites. Additional information was acquired from the Houston Canoe Club on areas within the region of importance to paddle sports. This information was compiled into the following three tables contained in *Appendix 3F*.

- *Region H-River Segments, Bay and Estuaries* – Lists all of the river basins, river segments, bays, and estuaries in the region and the recreational opportunities associated with each.

- *Recreation* – Lists all of the national parks, preserves, wildlife refuges, state parks, wildlife management areas, and forests and the recreational opportunities associated with each.
- *Region H-River Segments, Bay and Estuaries-Special Features* – Lists all of the lakes and reservoir segments in the region and the recreational opportunities associated with each.

From the tables containing the public recreational sites and data obtained from the *Galveston Bay Recreational User's Handbook*, Figure 3-10 was prepared to illustrate the location and each associated recreational activity for Region H. This map also shows the seasonal and restricted waterways within the region. *Appendix 1A* contains a detailed bibliography of all of the sources used for this section.

3.4 Total Water Supply

The total amount of water supply currently available to Region H from existing available water sources is 3,564,602 acre-feet per year. Of that, approximately 71 percent is surface water. By the years 2030 and 2060, the available supply is expected to be 3,371,447 acre-feet per year and 3,368,297 acre-feet per year, respectively. Table 3-12 below summarizes current and projected water supplies.

3.4.1 Water Supplies Available by City and Category

This water supply is distributed to each WUG, i.e. each city, each county-other, and each non-municipal water use category. This distribution is shown in *Table 3G.1*, located in *Appendix 3G*.

In *Table 3G.1*, the ground and surface water supply sources available to Region H are assigned to the various WUGs in the region based on contracts and water rights, limitations of conveyance facilities, and in some cases, current usage patterns. In general, a thorough search was performed to determine how each WUG obtained its water supply. This required identification of third-party contracts as well as water providers in addition to the wholesale water providers (WWPs).

About 72 percent of the year 2000 total available Region H supply is allocated to the region through one of the WWPs. Table 3-13 shows the distribution of the available supply among the providers for the study years of 2000, 2030, and 2060.

**Table 3-12
Summary of Water Supply Available for Region H
for Study Years 2000, 2030, and 2060**

Supply Source	Supply Available (acre-feet/year)		
	Year 2000	Year 2030	Year 2060
Groundwater			
Gulf Coast Aquifer	803,271	616,204	616,648
Carrizo-Wilcox Aquifer	10,940	9,756	9,610
Queen City Aquifer	7,906	7,906	7,906
Sparta Aquifer	17,414	17,414	17,414
Brazos River Alluvium	41,539	41,539	41,539
Yegua-Jackson Aquifer	6,400	6,400	6,400
Undifferentiated Aquifer	1,117	1,117	1,117
Subtotal	888,587	700,336	700,634
Surface Water			
Neches River Basin ¹	60,727	60,727	60,727
Neches-Trinity Coastal Basin	21,702	21,702	21,702
Trinity River Basin	1,605,262	1,605,262	1,605,262
Trinity-San Jacinto Brazos Coastal Basin	34,232	34,232	34,232
San Jacinto River Basin	303,900	300,600	297,300
San Jacinto-Brazos Coastal Basin	39,181	39,181	39,181
Brazos River Basin ¹	611,016	611,016	611,016
Brazos-Colorado Coastal Basin	12,019	12,019	12,019
Local Supplies, all basins	30,169	31,599	31,895
Subtotal	2,683,976	2,682,106	2,679,102
Total	3,572,563	3,382,442	3,379,736

¹ Supplies represent current contracts to Region H only. Total supply is greater but may not be available to Region H.

**Table 3-13:
Available Supply by Wholesale Water Provider within Region H
for Study Years 2000, 2030, and 2060**

Provider	Supply (acre-feet/year)		
	Year 2000	Year 2030	Year 2060
Baytown Area Water Authority	13,326	13,326	13,326
Brazos River Authority*	138,913	138,913	138,913
Brazosport Water Authority	23,017	23,017	23,017
Chambers-Liberty Counties Navigation District	79,020	79,020	79,020
Chocolate Bayou Water Company	100,972	100,972	100,972
Clear Lake City Water Authority	26,876	26,876	26,876
Dow Chemical	164,061	164,061	164,061
Fort Bend County WCID 1	6,890	6,890	6,890
Galveston County WCID 1	4,915	5,002	5,013
Gulf Coast Water Authority	207,703	207,703	207,703
City of Houston	1306,562	1,306,076	1,303,967
Lower Neches Valley Authority*	60,727	60,727	60,727
Lyondell-Citgo Refining	23,404	23,404	23,404
North Channel Water Authority	9,802	9,802	9,802
North Harris County Regional Water Authority	81,404	56,279	56,279
City of Pasadena	34,892	35,436	36,028
San Jacinto River Authority	197,164	196,636	189,065
Texas Genco	175,676	175,676	175,676
West Harris County Regional Water Authority	43,290	32,486	32,486
Total	3,747,169	3,519,536	3,519,939

*Supplies represent current contracts to Region H only. Total supply is greater but may not be available to Region H. Current BRA contracts represent 138.193 acre-feet of the 611.016 acre-feet. The remaining portion of the 611.016 acre-feet are other water rights.

General Methodology for Assigning Resources to WUGs

The following methodology summarizes the data collection process and the other procedures followed to arrive at the information in *Table 3G.1*. In general, the methodology includes the following steps.

Data Collection

- Identify contract supplies available to WUGs via a direct or multi-tier transaction with a WWP using contract information from WWPs and the 2001 Regional Water Plan.
- Coordinate with other planning regions to resolve interregional conflicts, where applicable. No interregional conflicts were identified during discussions with regions C, G, and I.
- Identify other possible water providers, using the TWDB Water Use Database and any other available information. Identify the end user WUGs that are supplied by these providers under a contractual or retail agreement. Contact these providers, and request contract information from them.
- Identify surface water supplies being used by self-supplied WUGs, by consulting the TCEQ Water Rights Database and *Table 3A.1*.
- Update information for water providers identified in the 2001 Regional Water Plan.

Groundwater Allocation

Groundwater supplies in Leon and Madison Counties were allocated according to information received from the Mid-East Texas Groundwater Conservation District. For all other counties, groundwater was first allocated to WUGs in each county, with the exception of Brazoria County. This is described below under Brazoria County. Where groundwater resources were not adequate to meet demands, supplies were distributed to WUGs based on total demand. Any exception to this rule is noted below.

Counties With Adequate Groundwater Resources

The available groundwater supplies in Austin, Leon, Madison, Polk, San Jacinto, Trinity and Walker Counties were found to be adequate to satisfy the groundwater demands of WUGs for the planning period.

Water was allocated to WUGs in Leon and Madison Counties and was allocated with guidance provided by the Mid-East Texas Groundwater Conservation District. The plan set forth by the district shows the amount of water allocated from each source to individual customers including irrigation, livestock, manufacturing, and mining users. These values were adjusted, within reasonable limits, to minimize shortages

Counties With Inadequate Groundwater Resources

Brazoria County

Brazoria County has municipal, manufacturing, mining, irrigation, and livestock water demands that cannot be entirely satisfied by surface water and groundwater resources. The groundwater availability of approximately 50,600 acre-feet per year can satisfy part of the water needs but not all of the needs in the county. For this reason, the communities of Alvin, Bailey's Prairie, Brookside Village, Danbury, Hillcrest, Holiday Lakes, Iowa Colony, Jones Creek, Manvel, Surfside Beach, Sweeny, and West Columbia were allocated groundwater to meet their entire demands while others were supplied groundwater in addition to surface water supplies. Adequate groundwater was also budgeted to supply the Brazoria County MUDs, Orbit Systems Inc., Southwest Utilities, and Varner Creek UD entirely from groundwater. After meeting the groundwater demands of these WUGs, the remaining groundwater supply was allocated among users that were connected to surface supplies as well as groundwater.

Brazoria was capable of providing for all of its demands through 2060 by using surface water supplies and was not allocated any of the county's groundwater resources. The communities of Clute, Oyster Creek, and Richwood were shown to experience shortages immediately in the 2000 period. However, no data supports that these shortages actually occurred. It is likely that these communities pump groundwater in excess of the groundwater supplies currently allocated to these communities shown in *Table 3G.1*. Freeport and Pearland would later develop shortages in 2020. Supplies to irrigation and county-other in the Brazos River Basin are anticipated to be insufficient to meet demands beginning in 2020. In the other basins, these shortages begin immediately. Manufacturing shortages in the Brazos and San Jacinto-Brazos River Basins begin in 2000 and 2020, respectively. Livestock demands that were not met by this groundwater supply were assumed to be provided by local water supplies. An adequate amount of local supplies was provided to mining WUGS to relieve shortages after applying other sources of water for the year 2000. This was considered a reasonable assumption as these WUGs are not currently experiencing shortages. These supply values were then carried through the 2060 planning period to represent the maximum amount of local supply available for mining for all periods.

Chambers County

Chambers County will experience groundwater shortages immediately in the 2000 planning period without the use of surface water supplies to meet its municipal, irrigation, manufacturing, mining, and livestock demands. Throughout all of the planning periods, the county will not be able to rely on groundwater supplies alone. Groundwater resources were distributed to each WUG receiving groundwater according to total demand.

Galveston and Harris Counties

Groundwater usage within Galveston and Harris Counties is regulated by HGCSO which provides for reductions in groundwater pumping in these counties based on a percent of total demand over the planning period. The groundwater reductions vary depending upon the Subsidence District area where the WUG is located.

WUGs located in Subsidence District Area 1 were limited to groundwater usage equal to 10 percent of their total demand for all planning periods from 2000 to 2060. In Area 2, WUG groundwater usage was limited to 20 percent of their total demand for the entire time period. Maximum groundwater usage for WUGs located in Area 3 varied by planning period. The maximum allowable groundwater use for 2010 was calculated to be 70 percent of the total water demand for the period, for each WUG. For 2020, this percentage was decreased to 30 percent. For subsequent years, only 20 percent of the total water demand could be met with groundwater sources. Irrigation WUGs within these counties were not subject to this limitation and could be allocated enough groundwater to meet the entirety of their demand. Because of this, the groundwater supplies set by HGCSO for Harris County were increased to meet the remaining portion of irrigation demands after all WUGs were provided their restricted portion of groundwater supply. This was not done for Galveston County, as irrigation demands were far greater than available groundwater supplies.

Shortages due to insufficient groundwater supply begin in the San Jacinto River Basin of Harris County in 2010. Before this time, shortages are due to groundwater restrictions. In the San Jacinto-Brazos and Trinity-San Jacinto Coastal Basins of the county, groundwater shortages through 2060 only occur due to groundwater pumping restrictions and not from limited supply. Municipal WUGs in Galveston County will experience shortages due to restrictions rather than limited supplies for all of the planning periods. Irrigation will not be able to entirely meet demands in this basin with groundwater alone. In the Neches-Trinity Coastal Basin, only livestock and mining WUGs are served by groundwater, and these users will experience shortages due to groundwater restrictions.

In instances where groundwater supplies were not adequate to meet groundwater demands or restricted groundwater demands, the amount supplied was prorated among the WUGs based on restricted demand, or total demand, if no restrictions applied. As the groundwater supplies available to users in Harris and Galveston Counties are based on subsidence restrictions rather than actual available amounts of groundwater and irrigators are not subject to HGCSO restrictions, it was assumed that this supply could be exceeded to meet any remaining irrigation demands after surface water was allocated to irrigation WUGs.

Fort Bend County

Similar to the subsidence restrictions imposed upon Harris and Galveston Counties by HGCSO, the FBSD regulates the quantity of groundwater pumpage in portions of Fort Bend County. However, these restrictions apply only to two zones in the northeastern portion of the county. For the sake of this plan, it was assumed that both zones would be required to lower pumpage to 70 percent of the total demand for each WUG during the 2020 planning period. For the 2030 period and beyond, it was assumed that only 40 percent of the total WUG demands could be met by groundwater. These limitations were not applied to irrigation usage within the county, and available groundwater supplies were increased in order to provide for irrigation demands remaining after groundwater was allocated to other WUGs.

The groundwater restrictions imposed by FBSD are not sufficient to prevent shortages due to supply from 2000 to 2060. The available amount of groundwater was distributed to WUGs

according to their demands or restricted demands, where applicable. As in Harris County, it was assumed that all groundwater demands to irrigators could be met by exceeding the aquifer supply. The FBSD restrictions do not apply to irrigators and small domestic wells and it is assumed that these users would pump the amount of water necessary to meet their demands. Therefore, the total available groundwater supplies were increased to accommodate the additional water usage by irrigators, as well as other unregulated WUGs, such as Pleak, that were not subject to subsidence restrictions.

Liberty County

Irrigation demands in Liberty County are of considerable magnitude. For this reason, groundwater was first provided to nonirrigation WUGs. The remaining groundwater was allocated to irrigation based on demand. Shortages appear in the 2000 period for irrigation in the Neches, Neches-Trinity, and Trinity San Jacinto River Basins. However, surface water supplies are adequate to prevent irrigation in the Trinity River Basin from experiencing further shortages until 2020.

Montgomery County

Available groundwater supplies are projected to be inadequate to meet demands in Montgomery County beginning in the 2010 planning period. At this point, several larger communities will be required to seek additional supplies. However, the communities of Cut and Shoot, Magnolia, Patton Village, Roman Forest, Splendora, and Woodbranch were allocated enough groundwater to satisfy their entire demand. Groundwater was allocated to the remaining WUGs proportional to each demand. The mining water demand remaining after including surface water contracts was fully met by local supplies. Livestock demands were met entirely from local supplies. The small irrigation demand in Montgomery County was supplied by surface water contracts from SJRA.

Waller County

The groundwater resources of Waller County were allocated for municipal, manufacturing, mining, irrigation, and livestock based on the groundwater available for the county. The estimated demands for groundwater within the county can be met with available groundwater supplies through the year 2050 when shortages will develop in the Brazos River Basin. The San Jacinto Basin will experience shortages in 2060. Katy, which receives groundwater from Harris County, will experience shortages due to the subsidence restrictions and limited supplies associated with the Harris County portion of the Gulf Coast Aquifer, San Jacinto River Basin.

Surface Water Allocation

- The values entered into *Table 3G.1* for municipal WUGs are the surface water supply identified from WWPs and smaller water providers.
- It was assumed that the COH provided enough water to meet its remaining surface water demands after the addition of water from other contract sales and groundwater allocation.

- Contracts from GCWA were found to exceed the total of the WWP's contracts from other providers and water rights. Because of this, all GCWA contracts were reduced by approximately 11 percent to ensure that available firm supplies were not exceeded.
- As a general rule, if a WUG is found in different counties, the supply allocated to the WUG in each county was split based on the surface water demand. In cases where this demand was "0," the supply was split equally between these counties. (The surface water demand for each entry WUG/county/basin was calculated by subtracting the allocated groundwater for that entry from that entity's total demand).
- Municipal contracts that were not identified as a municipal WUG were assumed to be a portion of County-Other and assigned to the appropriate county and basin unit.
- For non-municipal WUGs, contracts from water providers were used to determine contractual sources to various categories. Wherever possible, each contract was associated with a basin through available information.
- For non-municipal WUGs, some information was received from water rights information collected in the previous steps and entered in *Table 3A.1* on a WUG/county/basin basis. Ownership and use information for the available firm supplies was provided by the TCEQ Water Rights Database.
- Irrigation entries were compiled from contracts and firm water rights described later in this chapter.
- Livestock entries assumed livestock demands would be provided from local surface water supply sources. This is consistent with past TWDB procedures.
- Mining WUGs with shortages in 2000 were assumed to be supplied from local surface supplies equal to their shortage. This amount was also carried out for the remaining planning periods.

Data Collection

Entities that sell water to WUGs in the region were contacted in order to obtain an up-to-date list of their water commitments. This procedure was repeated at each tier of subsequent transactions until all of the contract water supplies provided by nonmajor water providers could be tracked to an end user, identified as a WUG or part of a WUG.

The remaining water supplies that were entered in *Table 3G-1* are other permit amounts or assumed local supplies. These entries are generally nonmunicipal users. Moreover, with the exception of livestock and mining supplies, the only noncontract supplies that were considered for *Table 3G-1* are the supplies associated with the records listed in *Table 3A-1*.

Supply Allocation

After the data collection process was completed, the contract and non-contract supplies were allocated to each WUG on a county/basin basis. If a portion of the water acquired through a

contract by a WUG was provided to another WUG, through a contract or direct retailing, or by using another intermediary seller, the amount associated with the initial WUG was modified accordingly to avoid double accounting of water. Within each category (county-other, manufacturing, mining, steam-electric, livestock, irrigation), all entities receiving water directly from the same source or obtaining water via contracts from the same provider/self provider and from the same source were aggregated into a single record.

Non-municipal contract supplies were allocated to a specific county/basin unit where possible. This involved the determination of the correct county and basin location for each recipient. Use of the historical data from the water use reports provided by TWDB was instrumental in this process. For example, the COH WWP currently has a wholesale contract with the manufacturing entity, Dixie Chemical Company. It was found that Dixie Chemical is using the water in Harris County in the San Jacinto-Brazos River Basin. Therefore, the current contract supply amount for Dixie Chemical would be added to the overall manufacturing supply available in Harris County, in the San Jacinto-Brazos Basin, and receiving water from the same source (in this case, Lake Livingston).

The allocation of the municipal contract supplies was more complex. Most of the water providers that receive water via a wholesale agreement have retail customers that are in their service areas. Retail customers are defined here as those recipients of water that pay for their service through some means other than a wholesale agreement (i.e., monthly billings). There is not a well-defined methodology for determining the amount of water available to these types of users. For the most part, the availability of water for these WUGs at the city/county level was assessed on a case-by-case basis. For those municipal WUGs that were divided into more than one basin, the availability to each basin was based on the basin's proportionate share of the city/county surface water demand.

For water rights for irrigation that were not found to be sold through contract, such as irrigation rights owned by individuals, the entire supply was allocated to irrigation. Irrigation contracts were used, where available, to determine what portion of a water provider's water right was actually sold for irrigation use. Most of the irrigation supplies are year-to-year contract supplies that are allocated differently with each growing season. For the most part, providers of irrigation water sell water to irrigators in their immediate vicinity. It was assumed that irrigation water rights provided water to the basin in which they originated unless known contracts allocated the water to another location. Contracted water supplies for irrigation were assumed to serve customers along the canal system in which it was conveyed.

For livestock demands not met by groundwater, it was assumed that there would be water available from local surface supply sources (i.e., stock ponds). Much of the mining demand for surface water also appeared to be supplied from local sources. However, it was assumed that these supplies would not increase in quantity over the planning period and alternative sources would be required to supplement any growth in demand. The year 2000 local supply quantity was held constant through the year 2060.

Municipal Contracts Allocation

Anahuac

The City of Anahuac receives 1,049 acre-feet per year from CLCND (nonmajor water provider). This amount was split between the Neches-Trinity and Trinity River Basins based on the surface water demand ratios, by basin.

Angleton

The City of Angleton receives approximately 2,016 acre-feet per year from Brazosport Water Authority (BWA) (nonmajor water provider), provides 202 acre-feet per year (approximately 10 percent) to manufacturing in the Brazoria County/San Jacinto-Brazos Basin (assumed that the split is for the entire length of the contract between City of Angleton and BWA). The amount remaining for the City of Angleton is 1,815 acre-feet per year.

Bacliff MUD

Bacliff MUD is contracted to receive 1,333 acre-feet per year from GCWA for municipal use. After adjusting this quantity in order to prevent GCWA contracts from exceeding supplies, Bacliff MUD will receive 1,185 acre-feet per year.

Bayou Vista

Bayou Vista receives 504 acre-feet per year from GCWA and is no longer a customer of the City of Galveston. This contract amount was reduced to 448 acre-feet per year so as not to exceed available supply.

City of Baytown

Baytown Area Water Authority (BAWA) receives 13,326 acre-feet per year from COH and provides water to several water supplies and to the City of Baytown. BAWA provided information regarding the amounts distributed to each of its customers. It was assumed that the BAWA customers Fresh Water Supply District 1-A, Harris County Fresh Water Supply District 1-B, Harris County Fresh Water Supply District 27, Lake MUD, Country Terrace, and Cedar Bayou represent county-other in the Trinity-San Jacinto Basin. The allocation of BAWA's contract is shown below.

- | | |
|---|-----------------|
| • Baytown | 11,036 ac-ft/yr |
| • Harris County WCID 1 | 670 ac-ft/yr |
| • Harris County-Other (Trinity-San Jacinto) | 798 ac-ft/yr |

The amount of water that the City of Baytown receives was calculated based on the surface water demand. The part of Baytown located in Harris County is also located in two different basins, Trinity-San Jacinto and San Jacinto. The amounts entered in these basins were prorated based on the surface water demands.

Bellaire

Bellaire receives 1,310 acre-feet per year of blended surface water and groundwater from the COH. As the groundwater reduction plan for the area progresses the amount of groundwater used will decrease significantly. The entirety of this contract was assumed to be made up of surface water and was allocated to municipal use.

Bolivar Peninsula SUD

Bolivar SUD contracts to receive 5,039 acre-feet per year from LNVA. It was assumed that 1 acre-feet per year of this contract could be used to provide water to county-other in the Neches-Trinity basin, leaving 5,038 acre-feet per year available to Bolivar SUD.

Brazoria

Brazoria has a contract with BWA for 336 acre-feet per year, and the entire contract was allocated to the City of Brazoria. The City of Brazoria is located in two different basins, the Brazos and Brazos-Colorado. The contract amount was prorated between these two basins based on the total water demand ratios for these two basins.

Bunker Hill Village

The COH provides 635 acre-feet per year of blended water to Bunker Hill Village. This entire supply was allocated as surface water as the portion of this supply from surface water will increase throughout the groundwater reduction plan.

Chimney Hill MUD

Chimney Hill MUD receives water under a contract from the COH. COH provides 420 acre-feet of groundwater/year to the MUD, and it was assumed the groundwater was obtained from the San Jacinto River Basin.

Clear Brook City MUD

The Clear Brook City MUD receives 1,680 acre-feet per year from the COH for municipal use. The MUD is a partner in the Southeast Water Purification Plant.

Clear Lake Shores

Based on information received from Galveston County WCID 12, this water provider serves Clear Lake Shores, Kemah, Lazy Bend (county-other), and a small number of customers in League City. Water provided to Kemah is sold wholesale to the City of Kemah, and then to other customers. All other sales by the district are carried out directly between WCID 12 and the customer. The WCID 12 contract from GCWA, after being reduced according to available supply, was split between Kemah and other customers in the district according to the ratio of usage between Kemah and WCID 12. The portion of water allocated to WCID 12 was further divided among Clear Lake Shores, League City, and county-other

according to the number of connections served in each community. The resulting volumes for each WUG are:

- Kemah 55 ac-ft/yr
- League City (Galveston County) 11 ac-ft/yr
- Lazy Bend (WCID 12) 134 ac-ft/yr
- Clear Lake Shores 689 ac-ft/yr

Clute

The City of Clute has a contract with BWA for 1,120 acre-feet per year; the entire contract was allocated to City of Clute.

County-Other in Brazoria County

BWA has contracts with Clemens Unit-TDCJ and Wayne Scott Unit-TDCJ for 420 acre-feet per year. The demands of these units were considered part of the county-other demand; therefore, since these units are located in Brazoria County, they were allocated to county-other in Brazoria County. The portion for the Clemens Unit was allocated to the Brazos-Colorado Basin while the Wayne Scott Unit supply contract was allocated to the San Jacinto-Brazos River Basin.

County-Other in Fort Bend County

Fort Bend County WCID 2 has an option contract with GCWA for 11,758 acre-feet per year. This contract was reduced so that GCWA contracts did not exceed supplies. Based on the information received from the contacted person, this amount, if used, would be split among its customers. Since GCWA provides retail water to its customers, an exact amount is difficult to estimate; therefore, GCWA estimated the amounts for each entity listed below:

- Missouri City 135 ac-ft/yr
- Sugar Land (San Jacinto-Brazos River Basin) 45 ac-ft/yr
- Harris County MUD 122 (assumed Harris County-other, San Jacinto River Basin) 296 ac-ft/yr
- Fort Bend County, unincorporated area (assumed Fort Bend County-other, San Jacinto-Brazos River Basin) 110 ac-ft/yr
- Stafford 9,865 ac-ft/yr

The amount indicated for Stafford and Missouri City was divided by basin and county according to surface water demand.

County-Other in Harris County

Several water providers including WWPs provide water to county-other in Harris County. These contributions are described below.

The provider with the alpha number 1095 in *Table 3G.1* is the La Porte Area Water Authority (LAWA). LAWA has a contract with COH for 8,734.6 acre-feet per year. According to the information received from LAWA, LAWA provides water to the cities of La Porte, Shoreacres, and Morgans Point. The volumes of water are shown below.

- Shoreacres 364 ac-ft/yr
- Morgans Point (entered as Harris County-Other) 616 ac-ft/yr
- City of La Porte 7,757 ac-ft/yr

As Morgans Point resides within both the San Jacinto and San Jacinto-Brazos River Basins, the water provided to county-other was split based on area. Because Morgans Point is divided fairly equally by the two basins, the 616 acre-feet per year was split in half.

North Channel Water Authority receives 6,681 acre-feet per year from COH that can be split among its customers. A summary of water usage for several years was provided by NCWA and used to prorate the COH contract amount among NCWA customers on a basis of their total water use. Municipal users that were not listed as individual WUGs were combined into county-other. The amount of contract water allocated to each WUG is shown below.

- Harris County FWSD 6 187 ac-ft/yr
- Harris County FWSD 47 288 ac-ft/yr
- Harris County FWSD 51 1,539 ac-ft/yr
- Harris County MUD 53 836 ac-ft/yr
- Harris County WCID 21 913 ac-ft/yr
- Harris County WCID 36 802 ac-ft/yr
- Harris County WCID 84 310 ac-ft/yr
- Pine Trails Utility 480 ac-ft/yr
- County-Other 281 ac-ft/yr
- Manufacturing 1,046 ac-ft/yr

The City of Pasadena receives water from COH, and it is one of the Southeast Purification Plant participants. Contract information was not available from the City of Pasadena and therefore information used in the 2001 Region H Regional Water Plan was used for the current plan. Based on the information received from the City of Pasadena for the 2001

Regional Water Plan, its customers are City of Seabrook (which in turn provides some of this water to the City of El Lago), manufacturing companies located in Harris County (San Jacinto-Brazos River Basin), and Clear Lake Water Authority (CLWA). These amounts are shown below.

- Seabrook and El Lago 1,120 ac-ft/yr
- County-Other 3,360 ac-ft/yr
- Manufacturing 5,040 ac-ft/yr

The remaining supply from Pasadena was assumed to be available to satisfy the demands of the City of Pasadena.

The Fort Bend County WCID 2 contract allocation was described under county-other in Fort Bend County. The amount allocated to county-other in Harris County is 349 acre-feet per year.

Baytown Area Water Authority provides water to several communities in Harris County that are not listed as WUGs. This water was allocated to Harris county-other. The BAWA contract allocation is described under Baytown.

Municipal customers of the COH that were not itemized as WUGs were combined into county-other, based on the customer's location. COH provides groundwater to the San Jacinto, San Jacinto-Brazos, and Trinity-San Jacinto River Basins for use by county-other WUGs.

The SJRA provides 896 acre-feet per year to Harris County MUD 19, located in the San Jacinto River Basin.

County-Other in Galveston County

The 267 acre-feet contract between GCWA and Bayview MUD was reduced to 237 acre-feet and allocated to county-other in Galveston County. The COH has a contract to supply Galveston County with 18,477 acre-feet per year for municipal use and it was assumed that this amount provided supply to the portion of Galveston County in the San Jacinto-Brazos basin. It was also assumed that the infrastructure that provides LNVA water to Bolivar SUD also provides water to county-other in the Neches-Trinity basin.

County-Other in Montgomery County

COH provides 381 acre-feet per year to Montgomery County MUD 98. The entirety of this amount was allocated to county-other.

County-Other in San Jacinto County

Waterwood MUD has a contract for 560 acre-feet per year. This supply was allocated to county-other in the Trinity River Basin.

County-Other in Trinity County

Three contracts from TRA were entered as county-other category in Trinity County. One of the contracts, listed for “Individual Domestic Use” was entirely allocated to county-other in Trinity County. Westwood Shores MUD is the recipient of 56 acre-feet per year from TRA, and it represents part of the demand of the county-other category in Trinity County. The other contract entered in this category is part of the Trinity County Regional Water Supply System (TCRWSS) contract. TCRWSS has a contract with TRA for 2,800 acre-feet per year through 2009, 3,360 acre-feet per year from 2010 through 2014, and 3,921 acre-feet per year following that. TCRWSS provides water, on a retail basis, to the WUGs of Trinity and Groveton, Riverside Water Supply, Trinity Rural Water Supply. It was assumed that enough water would be provided to each WUG TCRWSS serves to meet demands and that the remaining contract would be allocated to county-other in Trinity County.

County-Other in Walker County

Most of the contract of 11,202 acre-feet per year that the Huntsville Regional Water Supply System (HRWSS) has with TRA was allocated to the City of Huntsville. A small portion of this contract (15 percent) was allocated to county-other, based on our assumption that there are unincorporated areas in the vicinity of Huntsville that are supplied by the city. This amount was split by basin based on the surface water demand ratios.

Crosby

Crosby MUD serves the City of Crosby and has a contract with SJRA for 1,120 acre-feet per year. Based on the information received from the City of Crosby, all the water is used for residential purposes except a small amount that is supplied to a manufacturing company located in Harris County. The City of Crosby receives 1,050 acre-feet per year. The remaining 70 acre-feet is allocated to the manufacturing category in Harris County, San Jacinto River Basin.

Deer Park

The City of Deer Park has a contract with COH for 3,956 acre-feet per year, and Deer Park uses the entire amount for residential purposes. The contract was split by basins based on the surface water demand ratios.

Dickinson

Galveston County WCID 1 has a contract with GCWA for 5,224 acre-feet per year and provides this water to Dickinson, Texas City, and League City, which are all retail customers. The contract amount, after adjustment, is equal to 4,643 acre-feet per year. Based on the information received from Galveston County WCID 1, it provides water to 50 houses in Texas City, League City pays for 1 mgd (it currently uses 150,000 gallons/day), and the rest goes to Dickinson. For all decades, Texas City was allocated an amount equal to 2.5 persons/house and a 150 gallons per day per person. League City was allocated the 1 mgd contract.

El Lago

The City of Seabrook receives water from the City of Pasadena and then sells the water to El Lago. The volume of water provided by Pasadena was split between Seabrook and El Lago based on surface water demands.

Freeport

BWA has a contract with Freeport for 2,240 acre-feet per year. Based on the information received from the City of Freeport, 85 percent of this contract is allocated to the City of Freeport, and the remaining 15 percent is allocated to different manufacturers in the San Jacinto-Brazos and Brazos River Basins.

Friendswood

Friendswood has a contract with COH for 6,719 acre-feet per year and is one of the Southeast Purification Plant participants. The contract is entirely allocated to municipal use for the City of Friendswood. The contract was split in two entries in different counties, based on the surface water demand ratios for the two counties.

Galena Park

Galena Park has a contract with COH for 1,008 acre-feet per year. Galena Park personnel indicated that 94.6 percent of this contract goes to municipal use for the City of Galena Park. The remaining 5.4 percent of the contract amount is supplied to manufacturing use in Harris County in the San Jacinto River Basin. Galena Park receives 954 acre-feet per year. Manufacturing in the San Jacinto River Basin receives the balance of the contract, or 54 acre-feet per year.

Galveston

Galveston receives 23,505 acre-feet per year from GCWA, of which 20,893 acre-feet per year is a firm supply. This water is distributed among the city and two wholesale customers, Galveston County MUD 1 and Jamaica Beach. Galveston no longer serves customers that are not located on Galveston Island. As these customers receive water on a retail basis, it is difficult to determine a set amount provided to each one. Instead, this volume of water was divided among the three recipients according to their surface water demands in each decade.

Galveston County MUD 1

The Galveston County MUD 1 surface supply is divided out of the total supply from GCWA to the City of Galveston according to its demand ratio among the other two recipients as described under Galveston.

Galveston County WCID 12

The division of the GCWA supply to Galveston County WCID 12 and the WUGs it provides water to, is described under Clear Lake Shores.

Groveton

Groveton receives 200 acre-feet per year from TCRWSS, as explained in the county-other in Trinity County section above.

Harris County FWSD 6

Harris County FWSD is provided 187 acre-feet of water per year from NCWA as described under county-other in Harris County.

Harris County FWSD 47

Harris County FWSD 47 receives 288 acre-feet per year of water from NCWA. This amount was allocated as described under county-other for Harris County.

Harris County FWSD 51

Harris County FWSD 51 is also a customer of NCWA and is provided a portion of water according to the description under county-other in Harris County. The estimated supply to FWSD 51 is 1,539 acre-feet per year.

Harris County MUD 8

COH has a contract with Harris County MUD 8 to provide 420 acre-feet of groundwater.

Harris County MUD 53

NCWA provides an estimated 836 acre-feet per year of supply to Harris County MUD 53. This estimate is described for county-other in Harris County.

Harris County MUD 55

The COH provides 3,877 acre-feet per year to Harris County MUD 55. This contract is perpetual and was assumed to continue throughout the planning periods.

Harris County MUD 158

Harris County MUD 158 receives 411 acre-feet of groundwater per year from COH. It was assumed that this water originated from the San Jacinto River Basin.

Harris County MUD 261

Harris County MUD 261 and Windfern Forest UD receive 140 acre-feet of groundwater/year from COH. This amount was split between the two districts according to surface water demands.

Harris County WCID 1

BAWA has a contract to provide 670 acre-feet per year to Harris County WCID 1.

Harris County WCID 21

NCWA provides 913 acre-feet of water per year to Harris County WCID 21 as described under county-other in Harris County.

Harris County WCID 36

The description for county-other in Harris County explains the allocation of water from NCWA and includes the 802 acre-feet per year provided to Harris County WCID 36.

Harris County WCID 84

Harris County WCID 84 provides 310 acre-feet of water per year to Channelview from its source, NCWA. The assignment of this supply is described under county-other in Harris County.

Hedwig Village

Memorial Villages Water Authority (MVWA) has a contract with COH for 747 acre-feet per year of blended water. It was assumed for planning purposes that this water originated from a surface source. Based on the information received from MVWA, this contract is split between Hedwig Village, Piney Point Village, and Hunters Creek. Since these entities are retail customers, without information on exact amounts, the contract was split among the customers based on their total water demand ratios for each planning period.

Hitchcock

Hitchcock is a customer of GCWA and is contracted to receive 1,680 acre-feet per year on a perpetual basis. This volume was reduced to 1,493 to reflect GCWA supplies.

Houston

The City of Houston, in its capacity as water provider to residents within the city limits, receives its water from several sources that are operated as a system. The available supply of this system, less contracts to other parties, was assumed to make up the available supply for Houston. This total volume was distributed among the individual occurrences of the Houston WUG in each basin and county.

Additionally, the Clear Lake City Water Authority provides a portion of its contract from COH to areas of Houston. As some of the authority's contracts are indefinable, it was assumed that Webster and Pasadena received a share of water prorated by the area served in each community. The amount of water remaining was assumed to serve Clear Lake (a portion of the Houston WUG). The amounts of water provided to each CLCWA customer are shown below.

- City of Houston 8,076 ac-ft/yr
- City of Pasadena 8,619 ac-ft/yr

- Taylor Lake Village 1,730 ac-ft/yr
- Nassau Bay 2,184 ac-ft/yr
- Manufacturing 1,792 ac-ft/yr

Humble

The City of Houston provides 47 acre-feet of groundwater per year to Humble.

Hunters Creek Village

This entity receives its water from the MVWA. As described under Hedwig Village, the amount of water that MVWA receives from COH was shared among its customers based on the surface water demand ratios.

Huntsville

Huntsville receives water from the Huntsville Regional Water Supply System (HRWSS). Approximately 15 percent of this water is allocated to county-other to support surrounding communities. The remaining supply was allocated to the City of Huntsville.

Jacinto City

Jacinto City has a contract with COH for 1120 acre-feet per year, and the entire amount of the contract is allocated to municipal use in Jacinto City.

Jamaica Beach

The City of Galveston provides water to Jamaica Beach, as described under Galveston. The portion of water provided to Jamaica Beach for each planning period was prorated from the GCWA supply according to the surface water demands of each end user customer.

Kemah

Galveston County WCID 12 provides water to Kemah, as described for Clear Lake Shores.

La Marque

The GCWA contract to La Marque was reduced from 3,113 to 2,643 acre-feet per year. The contract is entirely allocated for municipal usage.

La Porte

The La Porte Area Water Authority receives water from COH and then distributes water to the City of La Porte and other customers. The City of La Porte receives 7,757 acre-feet per year, as described previously at county-other in Harris County. This contract was split between the city's WUGs in the San Jacinto and San Jacinto-Brazos River Basins.

Lake Jackson

Lake Jackson receives water from BWA, and the entire contract of 2,240 acre-feet per year is allocated to municipal use for Lake Jackson.

League City

League City receives the majority of its water from two providers, GCWA and Galveston County WCID 1. The League City contract with GCWA was reduced from 2,240 to 1,991 acre-feet per year. League City also contracts for 1 mgd with Galveston County WCID 1. Galveston County WCID 12 also provides a small amount of water to customers in a portion of League City in Harris County. This is shown under Clear Lake Shores.

Livingston

Livingston receives water from the Livingston Regional Water Supply System. The entire amount, 5,601 acre-feet per year, is allocated to Livingston for its municipal use.

Missouri City

Missouri City has a contract with GCWA for 16,797 acre-feet per year. However, this amount was reduced to 14,930 to reflect GCWA's limited supply. The other provider for Missouri City is Fort Bend WCID 2. The amount received by Missouri City from Fort Bend County WCID 2 is shown above, at county-other in Fort Bend County. Missouri City in Fort Bend County is split by basins based upon surface water demand ratios.

Nassau Bay

Nassau Bay receives water from Clear Lake Area Water Authority. The current amount contracted, 2,184 acre-feet per year, is assumed to remain constant through 2060. Nassau Bay uses the whole amount contracted for its municipal use.

North Harris County Regional Water Authority

NHCRWA has a contract with COH for 11 acre-feet per year until 2010. Beginning in 2010, the authority will receive 34,714 acre-feet of surface water/year.

Onalaska WSC

The Onalaska WSC receives 672 acre-feet per year from TRA.

Oyster Creek

Oyster Creek receives water from BWA, and the entire contract, 106 acre-feet per year, is allocated for municipal use in Oyster Creek.

Pasadena

Pasadena receives water from COH and from CLWA. The COH contract allocation is described under county-other in Harris County. The CLCWA contribution to Pasadena was described above under Houston.

Pearland

Pearland has a contract with GCWA for 11,198 acre-feet per year, valid until 2010, and a contract with COH for 560 acre-feet per year until 2041. Pearland is located in Harris and Brazoria Counties. Therefore, these contracts are split between the two counties based on surface water demand. The GCWA contract was reduced to 9,954 acre-feet per year to represent firm yield.

Pine Trails Utility

Pine Trails Utility is a customer of NCWA and receives 480 acre-feet per year as estimated under county-other in Harris County.

Piney Point Village

Memorial Villages Water Authority (MVWA) provides Piney Point Village with water from its contract with COH. As described above, under Hedwig Village and Hunters Creek Village, this contract is split between the MVWA customers.

Richwood

Richwood receives water from BWA, and the entire contract of 263 acre-feet per year is allocated for municipal use by Richwood.

Riverside WS Corp

Riverside WS Corp receives 20 acre-feet of water/year from TCRWS as mentioned above in county-other for Trinity County. This amount was allocated to Walker County as San Jacinto County had no shortages for this WUG.

San Jacinto WSC

San Jacinto Water Supply Corporation receives 280 acre-feet per year from TRA. Coldspring is included in their service area, but since Coldspring has enough groundwater to meet its demand, this contract was allocated entirely to the San Jacinto Water Supply Company.

San Leon

San Leon receives water from GCWA. The entire contract between GCWA and San Leon, 1,999 acre-feet per year, was reduced to 1,777 acre-feet per year and is allocated to the municipal use of San Leon.

Santa Fe

Santa Fe (Galveston County WCID 8) has a contract with GCWA for 1120 acre-feet per year. After considering contract reductions to limit GCWA contracted supplies, Santa Fe has 996 acre-feet per year available.

Seabrook

The Pasadena contract was split between El Lago and Seabrook as described under El Lago.

Shoreacres

La Porte provides water to Shoreacres, as shown in the allocation of the contract between the La Porte Area Water Authority and COH described under county-other in Harris County.

South Houston

As one of the Southeast Water Purification Plant partners, South Houston has a contract with COH for 4199 acre-feet per year. The contract is entirely allocated to municipal use for the City of South Houston.

Southside Place

Southside Place has a contract with COH for 319 acre-feet per year, and the entire contract is used to meet its municipal demands.

Stafford

Stafford receives water from Fort Bend County WCID 2. Fort Bend County WCID 2 has an option contract with GCWA. The contract allocation is described above at county-other in Fort Bend County. The amount that Stafford receives is split between Fort Bend County and Harris County based on surface water demand ratios. The amount allocated to the part of Stafford located in Fort Bend County is split by basins, between San Jacinto and San Jacinto-Brazos River Basins, based on their surface water demand ratios.

Sugar Land

Sugar Land has two water providers. Fort Bend County WCID 2 provides water to some residents of Sugar Land, and the amount allocated is described under county-other in Fort Bend County. This amount is assumed to serve the portion of Sugar Land located in the San Jacinto-Brazos River Basin. GCWA has a contract with the City of Sugar Land for 22,396 acre-feet per year. This contract was adjusted to 19,907 acre-feet per year and is entirely allocated to the City of Sugar Land for its municipal use. The GCWA contract amount was split by basins based on the surface water demand ratios.

Sunbelt FWSD

The City of Houston provides 187 acre-feet of groundwater per year to the Sunbelt FWSD, in addition to 299 acre-feet of blended water/year. This blended supply is assumed to be

surface water in *Table 3G.1*. Sunbelt is also a member of the COH Groundwater Reduction Plan.

Taylor Lake Village

Clear Lake City Water Authority provides 1,730 acre-feet of water per year to Taylor Lake Village. The allocation of the CLWA contract with COH was described under Houston.

Texas City

Texas City has two water providers. The entity providing the largest amount is GCWA. The contract from GCWA is 11,663 acre-feet per year and is used entirely by the City of Texas City for its municipal water usage. The actual firm amount of this contract is 10,367 acre-feet per year. The other provider is Galveston County WCID 1, and the allocation of its contract with GCWA is summarized under Dickinson. This small amount of water was estimated to be approximately 21 acre-feet per year.

Tiki Island

Tiki Island receives water from GCWA under a contract for 403 acre-feet per year. The adjusted contract amount is 358 acre-feet per year.

Trinity

Trinity receives water from TCRWSS. The allocation of the TCRWSS contract is described under county-other in Trinity County and is equal to the TWDB demands for Trinity.

Trinity Bay Conservation District

The Trinity Bay Conservation District receives 663 acre-feet per year from CLCND. LNVA provides an additional sum of water on an as-needed basis to the district through the Winnie Treatment Plant. When the new Winnie Water Treatment Plant is completed, the district will have the capacity to receive 2.4 mgd of water from LNVA. Therefore, it is assumed that the available supply from the Rayburn-Steinhagen system is 2,688 acre-feet per year. These supplies were split between the Trinity and Neches-Trinity River Basins according to demand.

Trinity Rural WS Corp

As described under county-other in Trinity County, Trinity Rural WSC supply is provided 160 acre-feet per year by TCRWSS. This entire amount was allocated to the Trinity Rural WSC in Walker County.

Webster

The City of Webster has a contract with COH for 4,535.27 acre-feet per year and is using the entire contract amount for its municipal water use. CLAWA provides an additional 4,475 acre-feet per year from their surface water allocation from COH.

West Harris County Regional Water Authority

WHCRWA will begin a contract with COH for 20,437 acre-feet per year in 2010. This amount was allocated between the portions of WHCRWA located in Harris and Fort Bend Counties based on surface water demand.

West University Place

The City of West University Place has a contract with COH for 2,052 acre-feet of groundwater/year, and it is using the entire contract amount for its municipal water use.

Windfern Forest UD

Windfern Forest UD shares a 140 acre-feet per year contract with Harris County MUD 261. This amount was split between the two districts according to their demands in each decade as described under Harris County MUD 261.

Manufacturing Supplies

BRAZORIA COUNTY

Brazoria County manufacturing supplies are allocated below.

Provider	2000	2010	2020	2030	2040	2050	2060
	(acre-feet/year)						
Angleton	202	202	202	202	202	202	202
CBWC	28,600	28,600	28,600	28,600	28,600	28,600	28,600
Dow	148,061	148,061	148,061	148,061	148,061	148,061	148,061
Freeport	336	336	336	336	336	336	336
GCWA	17,784	17,784	17,784	17,784	17,784	17,784	17,784
Individual Water Rights	12,019	12,019	12,019	12,019	12,019	12,019	12,019

The supply listed by the City of Angleton is provided from their contract from BWA. Chocolate Bayou Water Company provides 28,600 acre-feet per year to Amoco Chemical. It was assumed that this amount was provided for by CBWC's contract with GCWA and a portion of Water Right 3461105357A from Chocolate Bayou. The Dow supply represents the company's firm water right and assumes that the full quantity is either contracted to other entities or used for the Dow facility itself. Freeport allocates approximately 15 percent of its contract from BWA to manufacturing, providing the value listed above. The sum of GCWA contracts to manufacturers in the San Jacinto-Brazos River Basin totals 17,784 acre-feet per year (after adjustment in order to observe available supplies). All contract amounts were allocated to the basin in which the consumer was located. Water rights intended for manufacturing were allocated to the basin the source originated in.

FORT BEND COUNTY

Fort Bend County manufacturing supplies are allocated below.

Provider	2000 ac-ft/yr	2010 ac-ft/yr	2020 ac-ft/yr	2030 ac-ft/yr	2040 ac-ft/yr	2050 ac-ft/yr	2060 ac-ft/yr
FBC WCID 1	1,000	1,000	1,000	1,000	1,000	1,000	1,000

The Fort Bend County WCID 1 has a contract with Imperial Sugar for 1,000 acre-feet per year. Originally, this contract was for the entire 20,000 acre-feet per year yield from this right. However, this was reduced due to Imperial Sugar’s plant closure. This contract was allocated to the San Jacinto-Brazos River Basin.

GALVESTON COUNTY

Galveston County manufacturing supplies are allocated below.

Provider	2000 ac-ft/yr	2010 ac-ft/yr	2020 ac-ft/yr	2030 ac-ft/yr	2040 ac-ft/yr	2050 ac-ft/yr	2060 ac-ft/yr
GCWA	62,284	62,284	62,284	62,284	62,284	62,284	62,284

The GCWA amount represents the sum of contracts between the Gulf Coast Water Authority and manufacturers in Galveston County, San Jacinto-Brazos River Basin. This sum is adjusted so that the total GCWA contracts do not exceed supplies.

HARRIS COUNTY

Harris County manufacturing supplies are allocated below.

Provider	2000 ac-ft/yr	2010 ac-ft/yr	2020 ac-ft/yr	2030 ac-ft/yr	2040 ac-ft/yr	2050 ac-ft/yr	2060 ac-ft/yr
COH	380,961	380,961	380,961	380,961	380,961	380,961	380,961
Crosby	70	70	70	70	70	70	70
Galena Park	54	54	54	54	54	54	54
Pasadena	5,040	5,040	5,040	5,040	5,040	5,040	5,040
SJRA	76,952	76,952	76,952	76,952	76,952	76,952	76,952

The COH amount includes Houston and CWA contracts to manufacturers in Harris County. The appropriate portions of the contract sum were allocated to the basin in which the manufacturer was located. The supplies from Crosby and Galena Park represent portions of their contracted supplies provided for manufacturing. The Pasadena supply was split between the San Jacinto and San Jacinto-Brazos River Basins according to surface water demand. The sum of SJRA contracts was split according to the location of the contract customer.

A portion of the water provided by COH, equal to 23,404 acre-feet per year, is actually contracted to Lyondell-Citgo Refining WWP. This water is used for refinery processes by LCR as well as 16,733 acre-feet/year of steam-electric demand by a customer of LCR. Attempts were made to contact LCR regarding how this water is used, which user receives the water first, and which portion of the water is reused between the two users. Lyondell-Citgo was unable to provide any information regarding this use pattern and, therefore, the total sum of water has been shown in the shortage analysis and the table above with COH as the provider.

Irrigation Supplies

BRAZORIA COUNTY

Brazoria County irrigation allocations are tabulated below.

Irrigator	2000 ac-ft/yr	2010 ac-ft/yr	2020 ac-ft/yr	2030 ac-ft/yr	2040 ac-ft/yr	2050 ac-ft/yr	2060 ac-ft/yr
CBWC	67,247	67,247	67,247	67,247	67,247	67,247	67,247
Individual Water Rights	10,529	10,529	10,529	10,529	10,529	10,529	10,529

The CBWC supply is provided from the amount of Water Right 3461105357A remaining after contractual commitments to Amoco Chemical and the entirety of 3461205322B. As CBWC average annual contracts actually exceed the amount of this firm supply, it was assumed that the sum of these rights would be allocated to irrigation in the San Jacinto-Brazos River Basin. The water supply listed as individual water rights consists of the firm water rights within each basin. It was assumed that this water was used for agriculture within the source basin.

CHAMBERS COUNTY

Chambers County irrigation allocations are tabulated below.

Irrigator	2000 ac-ft/yr	2010 ac-ft/yr	2020 ac-ft/yr	2030 ac-ft/yr	2040 ac-ft/yr	2050 ac-ft/yr	2060 ac-ft/yr
CLCND	10,000	10,000	10,000	10,000	10,000	10,000	10,000
LNVA	33,300	33,300	33,300	33,300	33,300	33,300	33,300
TRA	17,309	16,818	16,552	16,370	16,170	15,941	15,669
Individual Water Rights	23,995	23,995	23,995	23,995	23,995	23,995	23,995

The CLCND amount represents the volume of water provided to Devers Canal customers in the Neches-Trinity River Basin by the CLCND. The LNVA amount is the sum of annual

irrigation contracts to individuals in the Neches-Trinity River Basin. The water supplied by TRA represents the amount contributed to the Devers Canal system, split between Chambers and Liberty Counties according to irrigation surface demand in the basins served by the canal. In Chambers County, this water was only provided to the Neches-Trinity River Basin. Individual water rights for irrigation were assumed to be applied within the basin from which they originated.

FORT BEND COUNTY

Fort Bend County irrigation allocations are tabulated below.

Irrigator	2000 ac-ft/yr	2010 ac-ft/yr	2020 ac-ft/yr	2030 ac-ft/yr	2040 ac-ft/yr	2050 ac-ft/yr	2060 ac-ft/yr
CBWC	5,625	5,625	5,625	5,625	5,625	5,625	5,625
GCWA	1,098	1,098	1,098	1,098	1,098	1,098	1,098
Texas Genco	20,944	20,944	20,944	20,944	20,944	20,944	20,944

The irrigation from CBWC represents the contract between the Brazos River Authority to the South Texas Water Company, a portion of the Chocolate Bayou Water Company. The entirety of this amount was allocated to the Brazos River Basin. The GCWA supply represents the adjusted contract amounts between GCWA and several irrigators in the San Jacinto-Brazos River Basin. The supply from Texas Genco represents the firm irrigation supply from the Brazos River Basin contracted to Richmond Irrigation. It was assumed that this entire amount was used within the Brazos River Basin. The balance of this water right was allocated to steam-electric in the Brazos basin.

GALVESTON COUNTY

Galveston County irrigation allocations are tabulated below.

Irrigator	2000 ac-ft/yr	2010 ac-ft/yr	2020 ac-ft/yr	2030 ac-ft/yr	2040 ac-ft/yr	2050 ac-ft/yr	2060 ac-ft/yr
GCWA	109	109	109	109	109	109	109

The GCWA allocated amounts equal the contracted volume of water to irrigation users in Galveston County.

HARRIS COUNTY

Harris County irrigation allocations are tabulated below.

Irrigator	2000 ac-ft/yr	2010 ac-ft/yr	2020 ac-ft/yr	2030 ac-ft/yr	2040 ac-ft/yr	2050 ac-ft/yr	2060 ac-ft/yr
SJRA	738	738	738	738	738	738	738
Individual Water Rights	1,254	1,254	1,254	1,254	1,254	1,254	1,254

The SJRA amount is equal to the current irrigation contracts between SJRA and customers in Harris County. It was assumed that these annual contracts ran perpetually and that they served irrigation demands in the San Jacinto River Basin.

LIBERTY COUNTY

Liberty County irrigation allocations are tabulated below.

Irrigator	2000 ac-ft/yr	2010 ac-ft/yr	2020 ac-ft/yr	2030 ac-ft/yr	2040 ac-ft/yr	2050 ac-ft/yr	2060 ac-ft/yr
COH	33,000	33,000	33,000	33,000	33,000	33,000	33,000
Devers Canal	2,500	2,500	2,500	2,500	2,500	2,500	2,500
LNVA	19,700	19,700	19,700	19,700	19,700	19,700	19,700
TRA	10,191	10,682	10,948	11,130	11,130	11,559	11,831

The COH supply was purchased from the Dayton Canal Irrigation Company and is assumed to be provided to irrigators within the Trinity River River Basin. The Devers Canal irrigation supply listed above is from a water right from the Trinity River and was split between the basins served by the Devers Canal system based on demand. The LNVA amount is the sum of the authority's contracts to individual farmers, assumed to be located in the Neches-Trinity River Basin. The volume of water provided to irrigation by TRA is Liberty County's share of the TRA contribution to the Devers Canal system. The water rights available to irrigation in Liberty County were allocated to the basin in which the supply originated.

MONTGOMERY COUNTY

Montgomery County irrigation allocation is tabulated below.

Irrigator	2000 ac-ft/yr	2010 ac-ft/yr	2020 ac-ft/yr	2030 ac-ft/yr	2040 ac-ft/yr	2050 ac-ft/yr	2060 ac-ft/yr
SJRA	497	497	497	497	497	497	497

The SJRA amount is the sum of water contracts between SJRA and irrigators in Montgomery County. These year to year contracts were assumed to be renewed through 2060.

POLK COUNTY

Polk County irrigation allocation is tabulated below.

Irrigator	2000 ac-ft/yr	2010 ac-ft/yr	2020 ac-ft/yr	2030 ac-ft/yr	2040 ac-ft/yr	2050 ac-ft/yr	2060 ac-ft/yr
TRA	20	20	20	20	20	20	20

The TRA amount allocated is the sum of contracts to Memorial Point Townhouse Association and Fountain Lake Townhouse Association. These users represent minor irrigators and, therefore, no irrigation demand is shown for Polk County and this supply is not shown in *Table 3G.1*.

SAN JACINTO COUNTY

San Jacinto County irrigation allocation is tabulated below.

Irrigator	2000 ac-ft/yr	2010 ac-ft/yr	2020 ac-ft/yr	2030 ac-ft/yr	2040 ac-ft/yr	2050 ac-ft/yr	2060 ac-ft/yr
TRA	175	175	175	175	175	175	175

The TRA amount allocated is the sum of two contracts between Royal Pines and Waterwood National Resort and TRA.

TRINITY COUNTY

Trinity County irrigation allocation is tabulated below.

Irrigator	2000 ac-ft/yr	2010 ac-ft/yr	2020 ac-ft/yr	2030 ac-ft/yr	2040 ac-ft/yr	2050 ac-ft/yr	2060 ac-ft/yr
TRA	270	270	270	270	270	270	270

The TRA amount allocated is a lump sum of contracts between several water recipients and TRA. The sum of these contracts, 270 acre-feet per year, is the sum of all the individual irrigation amount contracts in Trinity County.

WALKER COUNTY

Walker County irrigation allocation is tabulated below.

Irrigator	2000 ac-ft/yr	2010 ac-ft/yr	2020 ac-ft/yr	2030 ac-ft/yr	2040 ac-ft/yr	2050 ac-ft/yr	2060 ac-ft/yr
TRA	10	10	10	10	10	10	10

The TRA amount represents the irrigation contracts between the authority and irrigators in Walker County, Trinity River Basin.

Mining Supplies

FORT BEND COUNTY

Fort Bend County mining supplies are allocated below:

Provider	2000 ac-ft/yr	2010 ac-ft/yr	2020 ac-ft/yr	2030 ac-ft/yr	2040 ac-ft/yr	2050 ac-ft/yr	2060 ac-ft/yr
BRA	1,100	1,100	1,100	1,100	1,100	1,100	1,100
GCWA	822	822	822	822	822	822	822

The BRA portion is contracted to CSB materials and provides for mining in the Brazos River Basin. The GCWA contract provides water to Texas Brine in the San Jacinto-Brazos River Basin.

Steam-Electric Supplies

CHAMBERS COUNTY

Chambers County steam-electric supplies are allocated below:

Provider	2000 ac-ft/yr	2010 ac-ft/yr	2020 ac-ft/yr	2030 ac-ft/yr	2040 ac-ft/yr	2050 ac-ft/yr	2060 ac-ft/yr
Texas Genco	30,000	30,000	30,000	30,000	30,000	30,000	30,000

The portion shown above is provided through Water Right 3460903926 from Cedar Bayou owned by Texas Genco.

FORT BEND COUNTY

Fort Bend County steam-electric supplies are allocated below:

Provider	2000 ac-ft/yr	2010 ac-ft/yr	2020 ac-ft/yr	2030 ac-ft/yr	2040 ac-ft/yr	2050 ac-ft/yr	2060 ac-ft/yr
Texas Genco	126,276	126,276	126,276	126,276	126,276	126,276	126,276

The sum of supplies represents two individual rights owned by Texas Genco for use in the Brazos River Basin (Water Rights 3461205320 and 3461205325) and a contract from BRA for 83,000 acre-feet per year.

GALVESTON COUNTY

Galveston County steam-electric supplies are allocated below:

Provider	2000 ac-ft/yr	2010 ac-ft/yr	2020 ac-ft/yr	2030 ac-ft/yr	2040 ac-ft/yr	2050 ac-ft/yr	2060 ac-ft/yr
GCWA	8,405	8,405	8,405	8,405	8,405	8,405	8,405

The GCWA portion represents the sum of two contracts to steam-electric WUGs in the San Jacinto-Brazos River Basin. These contracts have been adjusted according to the procedures outlined above to limit GCWA contracts to available supplies.

HARRIS COUNTY

Harris County steam-electric supplies are allocated below:

Provider	2000 ac-ft/yr	2010 ac-ft/yr	2020 ac-ft/yr	2030 ac-ft/yr	2040 ac-ft/yr	2050 ac-ft/yr	2060 ac-ft/yr
COH	14,367	14,367	14,367	14,367	14,367	14,367	14,367
Individual Water Rights	2,120	2,120	2,120	2,120	2,120	2,120	2,120

The COH supply is provided to two steam-electric WUGS in the San Jacinto River Basin. Water Right 3461105350 from Clear Creek is assumed to be used by Texas Genco for use in power generation.

MONTGOMERY COUNTY

Montgomery County steam-electric supplies are allocated below:

Provider	2000 ac-ft/yr	2010 ac-ft/yr	2020 ac-ft/yr	2030 ac-ft/yr	2040 ac-ft/yr	2050 ac-ft/yr	2060 ac-ft/yr
SJRA	4,996	4,996	4,996	4,996	4,996	4,996	4,996

The SJRA supply from Lake Conroe provides water to Entergy for steam-electric use.

3.4.2 Wholesale Water Providers

The resources available to Region H through Wholesale Water Providers (WWPs) are listed in *Appendix 3H* in *Table 3H.1*. This list was compiled with the use of the TCEQ Water Rights Database, WAM and GAM results, contract information and clarifications received directly from the WWPs, and the allocation of groundwater resources shown above.

For the sake of this study, water supplies from the CWA have been included with the data for COH. Similarly, water provided by the Trinity County Regional Water Supply System,

Huntsville Regional Water Supply System, and Livingston Regional Water Supply System have been listed as TRA as these providers are operated by TRA.

The groundwater supplies shown in *Table 3H.1* represent the groundwater supplied to a WUG by the WWP and not groundwater used by a WUG from its own wells. These amounts of groundwater are generally the available supply as determined by the groundwater allocation method described above. However, COH was known to provide specified amounts of groundwater to its contract customers. Therefore, for the COH WWP, the available supply of groundwater is equal to the groundwater supplied to the Houston WUG plus the sum of groundwater contracts to customers. The groundwater available to NCWA is equal to the sum of groundwater allocated to its customers as it was assumed that NCWA is the only source of water for these customers. Galveston County WCID 1 was allocated the groundwater associated with Dickinson as part of its available supply. The Woodlands is provided water by SJRA, and the groundwater that was available to The Woodlands was assumed to originate from SJRA. Finally, NHCRWA, the City of Pasadena, WHCRWA, and the City of Huntsville were allocated the groundwater associated with each of the WUGs by the same name.

The volume of WWP supplies available to individual WUGs was determined through contract information from the WWPs, previous records, and further clarification from both the providers and customers. Where it was not possible to determine specific contract amounts to each WUG, other methods were used to approximate the supply to each WUG as described above in the groundwater and surface water allocation sections.

The 2060 supplies available to each WWP are shown below in Table 3-14. Wholesale Water Providers that receive water from another WWP through contractual transfer are listed below the original provider.

The surface water supplies are summarized by county, basin and category of use in Table 3-15. The current surface water supplies are summarized by category of water use by basin by WWP in *Table 3H.2*.

Table 3-14: Summary of Supplies Available to Region H Wholesale Water Providers in 2060

Wholesale Water Provider*	Available Supplies (acre-feet)		
	Contracts**	Groundwater	Surface Rights
Brazos River Authority ¹			138,913
Dow Chemical Company	16,000		148,061
Gulf Coast Water Authority ²	32,668		175,035
Chocolate Bayou Water Company ³	19,560		81,412
Galveston County WCID 1 ⁴	4,643	370	
Texas Genco ⁵	84,925		90,751
Brazosport Water Authority			23,017
Chambers-Liberty Counties Navigation District ⁶			79,020
Fort Bend County WCID 1			6,890
City of Houston ⁷		86,619	1,217,348
Baytown Area Water Authority	13,326		
Clear Lake City Water Authority ⁸	26,876		
La Porte Area Water Authority	8,735		
Lyondell-Citgo Refining	23,404		
North Channel Water Authority ⁹	6,682	3,120	
North Harris County Regional Water Authority	34,714	21,565	
City of Pasadena ¹⁰	33,035	2,993	
West Harris County Regional Water Authority	20,437	12,049	
Lower Neches Valley Authority ¹¹			60,727
San Jacinto River Authority ¹²		7,859	181,206
Trinity River Authority			403,200
City of Huntsville	11,202	5,269	

*WWPs that provide water through contract to other WWPs are shown with the customer WWPs listed below the sellers.

**Water received under contract from another WWP.

- ¹ Demands represent contractual agreements to Region H customers only. Supply quantities are for the amount of water currently contracted to Region H customers by BRA.
- ² GCWA contracts exceed available firm yield supplies. For the purpose of the shortage analysis, contracts were prorated to not exceed supplies.
- ³ CBWC manufacturing and average irrigation sales exceed firm supplies. For the purpose of the shortage analysis, it was assumed that irrigation contracts would be reduced. CBWC receives water through a contract with both BRA and GCWA.
- ⁴ Supplies include GCWA contract and maximum amount of groundwater allowed for Dickinson per HGCSO regulations.

- ⁵ Demands include contractual demands to Richmond Irrigation and Brazos Valley Energy, as well as the entire portion of the GCWA contract, which is assumed to be used by Texas Genco. Actual demands may be greater but are overall split among supply sources since actual data is unavailable.
- ⁶ CLCND supply includes rights from Lake Anahuac, less 30,000 acre-feet sold to SJRA.
- ⁷ Groundwater supply includes the portion of groundwater provided to Houston after prorating available, restricted supplies to WUGs, plus groundwater contracted to other WWP. Demands include contracts to BAWA, CLCWA, LPAWA, Lyondell-Citgo, NCWA, NHCRWA, Pasadena, and WHCRWA WWP. Surface water rights for COH include 33,000 acre-feet purchased from the Dayton Canal Irrigation Company; it is allocated entirely to irrigation demands in Liberty County.
- ⁸ Assumes all water remaining after contracts is provided to Clear Lake (Houston WUG).
- ⁹ NCWA groundwater supply estimated from the 2003-2004 ratio of groundwater to contract water. Demands were assumed to equal supplies.
- ¹⁰ Includes total Pasadena demands, less the portion met by CLCWA.
- ¹¹ Demands represent contractual agreements to Region H customers only. Supply quantities are for the entire Rayburn-Steinhagen system and do not represent the portion available to Region H.
- ¹² Includes water demands and available groundwater supplied to The Woodlands. The 2060 groundwater supply shown above is the least amount of groundwater available throughout the planning periods. Also includes 14,944 acre-feet of permitted indirect reuse.

Table 3-15: Surface Water Supply by Categories of Water Use in Each County and Basin

County	Basin	Use	Available Supplies (acre-feet)						
			Year 2000	Year 2010	Year 2020	Year 2030	Year 2040	Year 2050	Year 2060
Austin	Colorado	Livestock	48	52	56	58	59	60	61
Brazoria	Brazos	Municipal	258	433	459	443	432	422	414
		Manufacturing	164,348	250,477	250,477	276,477	276,476	311,781	317,401
		Mining	190	398	398	398	398	398	398
		Irrigation	2,300	3,430	3,430	3,430	3,430	3,430	3,430
		Livestock	184	220	228	232	235	236	238
	Brazos - Colorado	Municipal	478	3,119	3,119	3,119	3,119	3,119	3,119
		Manufacturing	12,019	12,019	12,019	12,019	12,019	12,019	12,019
		Mining	1,124	1,412	1,561	1,679	1,797	1,943	2,093
		Irrigation	0	1,971	1,971	1,971	1,971	1,971	1,971
		Livestock	196	200	202	206	210	217	225
	San Jacinto - Brazos	Municipal	19,789	33,380	34,252	39,776	39,913	39,931	39,946
		Manufacturing	46,635	46,634	46,634	57,284	57,285	57,305	57,285
		Mining	305	750	750	750	750	750	750
		Irrigation	75,476	86,094	86,094	86,094	86,094	86,094	86,094
		Livestock	610	545	505	547	591	643	690
	Chambers	Neches - Trinity	Municipal	3,112	3,159	3,159	3,158	3,159	3,157
Mining			505	778	778	778	778	778	778
Irrigation			82,311	81,820	81,554	81,372	81,172	80,943	80,671
Livestock			317	317	317	317	317	317	318
Trinity		Municipal	1,288	2,970	2,970	2,971	2,970	2,972	2,971
		Mining	18,989	30,539	30,539	30,539	30,539	30,539	30,539
		Irrigation	0	22,059	22,059	22,059	22,059	22,059	22,059
		Livestock	49	50	50	50	50	51	51
Trinity - San Jacinto		Municipal	520	1,673	1,721	1,762	1,793	1,824	1,853
		Manufacturing	0	13,445	13,445	13,445	13,445	13,445	13,445
		Mining	4,722	8,558	8,558	8,558	8,558	8,558	8,558
		Irrigation	2,293	2,293	2,293	2,293	2,293	2,293	2,293
		Steam Electric	30,000	30,000	30,000	30,000	30,000	30,000	30,000
		Livestock	46	48	49	51	52	53	54
Fort Bend		Brazos	Municipal	14,306	39,130	38,213	52,645	52,642	66,636
	Manufacturing		0	1,140	1,140	1,140	1,140	1,140	1,140
	Mining		1,100	1,100	1,100	1,100	1,100	1,100	1,100
	Irrigation		26,569	26,569	26,569	26,569	26,569	26,569	26,569
	Steam Electric		120,687	120,687	120,687	120,687	120,687	120,687	120,687
	San Jacinto	Livestock	0	0	207	415	415	415	415
		Municipal	4,336	24,212	27,795	55,475	56,424	59,159	60,608
		Manufacturing	0	1,550	1,550	1,550	1,550	1,550	1,550
		Mining	8	202	202	202	202	202	202
		Livestock	2	13	30	47	47	47	47
	San Jacinto - Brazos	Municipal	29,821	39,668	40,941	57,108	57,647	78,838	79,777
		Manufacturing	1,000	2,969	2,969	2,969	2,969	2,969	2,969
		Mining	822	1,482	1,482	1,482	1,482	1,482	1,482
		Irrigation	1,098	1,098	1,098	1,098	1,098	1,098	1,098
		Livestock	46	64	98	139	139	139	139

Table 3-15: Surface Water Supply by Categories of Water Use in Each County and Basin (Continued)

County	Basin	Use	Available Supplies (acre-feet)							
			Year 2000	Year 2010	Year 2020	Year 2030	Year 2040	Year 2050	Year 2060	
Galveston	Neches - Trinity	Municipal	5,039	5,039	5,039	5,039	5,039	5,039	5,039	
		Mining	106	122	129	132	135	139	142	
	San Jacinto - Brazos	Municipal	71,429	75,864	76,330	76,943	76,972	76,974	76,960	
		Manufacturing	62,284	62,284	62,284	62,284	62,284	90,284	90,284	
		Mining	101	134	134	134	134	134	134	
		Irrigation	109	7,860	7,526	6,981	6,978	6,994	7,021	
		Steam Electric	8,405	8,405	8,405	8,405	8,405	8,405	8,405	
Livestock	296	306	296	280	280	280	281			
Harris	San Jacinto	Municipal	301,644	414,858	641,098	688,748	736,778	823,560	877,931	
		Manufacturing	364,506	364,506	431,706	431,734	431,743	431,748	431,746	
		Mining	992	1,258	1,771	1,771	1,771	1,771	1,771	
		Irrigation	738	738	738	738	738	738	738	
		Steam Electric	14,367	14,367	31,062	31,062	31,062	43,662	43,662	
		Livestock	0	324	666	803	803	803	803	
	San Jacinto - Brazos	Municipal	59,463	59,271	60,488	62,065	63,870	65,871	68,090	
		Manufacturing	57,391	60,226	71,652	71,624	71,615	74,081	74,083	
		Mining	19	34	34	34	34	34	34	
		Steam Electric	2,120	2,120	2,120	2,120	2,120	2,395	2,395	
		Livestock	82	82	82	82	82	82	82	
	Trinity - San Jacinto	Municipal	12,680	12,639	12,593	12,555	12,526	12,497	12,470	
		Manufacturing	42,972	75,298	89,318	89,318	89,318	89,318	89,318	
		Irrigation	1,254	1,254	1,254	1,254	1,254	1,254	1,254	
		Livestock	73	73	73	73	73	73	73	
	Liberty	Neches	Irrigation	2,500	2,500	2,500	2,500	2,500	2,500	2,500
			Livestock	45	45	45	45	45	45	70
Neches - Trinity		Irrigation	19,348	20,269	20,228	20,199	20,170	20,134	19,593	
		Irrigation	43,543	47,113	47,420	47,631	47,860	48,125	48,438	
Trinity - San Jacinto		Irrigation	685	12,185	12,185	12,185	12,185	12,185	9,685	
		Livestock	0	0	0	0	0	0	17	
Montgomery	San Jacinto	Municipal	0	44,735	79,547	129,636	129,750	129,915	130,120	
		Manufacturing	0	2,442	2,442	2,442	2,442	2,442	2,442	
		Mining	0	413	413	413	413	413	413	
		Irrigation	497	497	497	497	497	497	497	
		Steam Electric	4,996	4,996	4,996	4,996	11,881	11,881	11,881	
		Livestock	510	510	510	510	510	510	510	
Polk	Trinity	Municipal	6,279	6,279	6,280	6,281	6,281	6,282	6,282	

Table 3-15: Surface Water Supply by Categories of Water Use in Each County and Basin (Continued)

County	Basin	Use	Available Supplies (acre-feet)						
			Year 2000	Year 2010	Year 2020	Year 2030	Year 2040	Year 2050	Year 2060
San Jacinto	Trinity	Municipal	840	840	840	840	840	840	840
		Irrigation	175	675	675	675	675	675	675
Trinity	Trinity	Municipal	4,970	4,995	5,016	5,016	5,000	4,980	4,965
		Irrigation	270	270	270	270	270	270	270
		Livestock	211	211	211	211	211	211	211
Waller	Brazos	Livestock	232	232	232	232	232	242	277
Waller	San Jacinto	Municipal	0	111	111	111	111	111	111
		Livestock	90	90	90	90	90	102	107
Walker	San Jacinto	Municipal	0	0	352	2,881	2,124	2,279	2,555
		Livestock	0	0	1	12	8	9	11
	Trinity	Municipal	11,242	11,244	10,894	8,365	9,121	8,966	8,690
		Irrigation	10	10	10	10	10	10	10
		Livestock	71	106	127	138	143	148	154