

## 2 – WATERSHED INVENTORY AND CHARACTERIZATION

### PHYSICAL AND NATURAL FEATURES

#### WATERSHED BOUNDARIES

The San Bernard River Watershed is over 125 miles long and covers approximately 900 square miles. The headwaters of the San Bernard River originate in New Ulm in Austin County. The river flows through Austin, Colorado, Wharton, Fort Bend, and Brazoria Counties. The river ultimately drains to the Gulf of Mexico, just past the Intercoastal Waterway. The San Bernard River watershed is bounded on the north and east by the Brazos River basin and on the south and west by the Colorado River basin and Caney Creek.

The San Bernard River comprises two stream segments defined by TCEQ. Stream segment 1302 is the San Bernard River above-tidal, which flows from the town of New Ulm in Austin County to a point 2.0 mi upstream of State Highway 35 in Brazoria County. Stream segment 1301 is San Bernard River tidal, which flows from 2.0 mi upstream of State Highway 35 in Brazoria County to the Gulf of Mexico in Brazoria County.

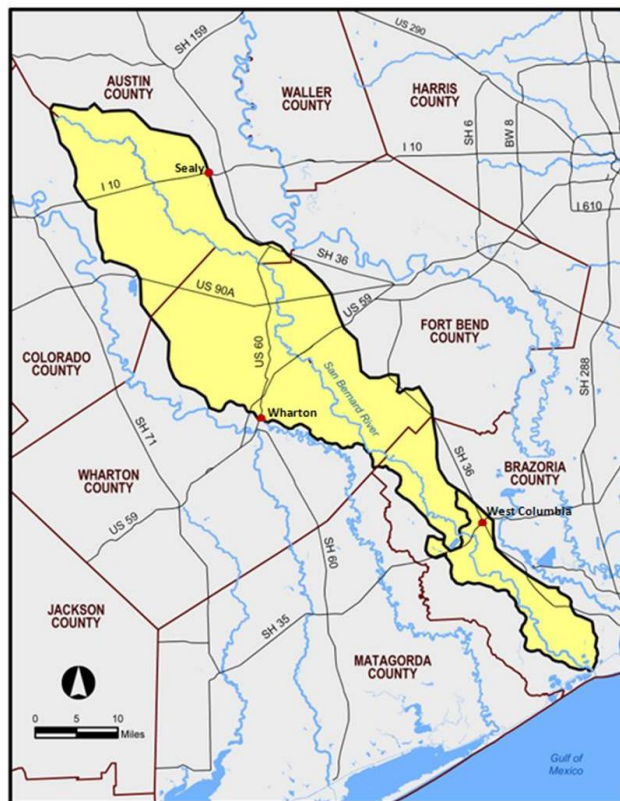


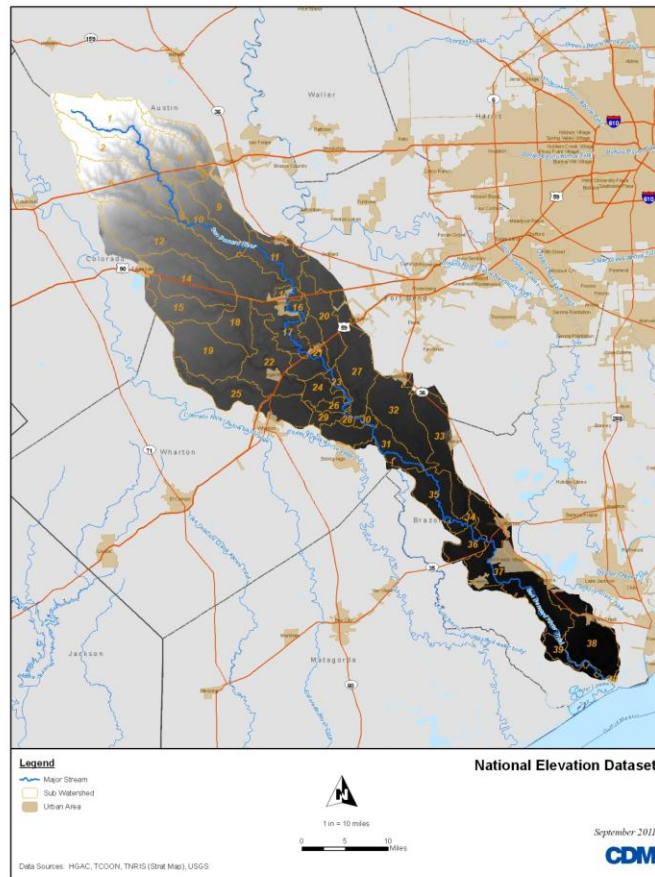
FIGURE 1 - LOCATION OF SAN BERNARD WATERSHED

## TOPOGRAPHY

The terrain throughout the watershed is characterized by level to undulating plains rising to the north with a timber belt of hardwoods along the river. Closer to the mouth of the river the terrain is Bay Prairie where prairie grasses, bunch grasses, mesquite, and oak predominate. Elevations in the watershed vary between 0" to 400". The San Bernard Watershed is ideally suited for farming and ranching as the land is fairly flat.

The lower portion of the watershed near the Gulf Coast is characterized by Gulf Coast Prairies and Marshes Ecoregion. Elevation is generally 5 feet or less above mean sea level with a few areas 10 feet or more above sea level.

The Texas Gulf Coast has low-lying coastal landforms that include barrier islands, peninsulas, offshore sand bars, bays, mudflats, dunes, and shoals. These landforms are subject to the activities of waves, winds, storms, tides, climate, rising sea levels, and human activities.



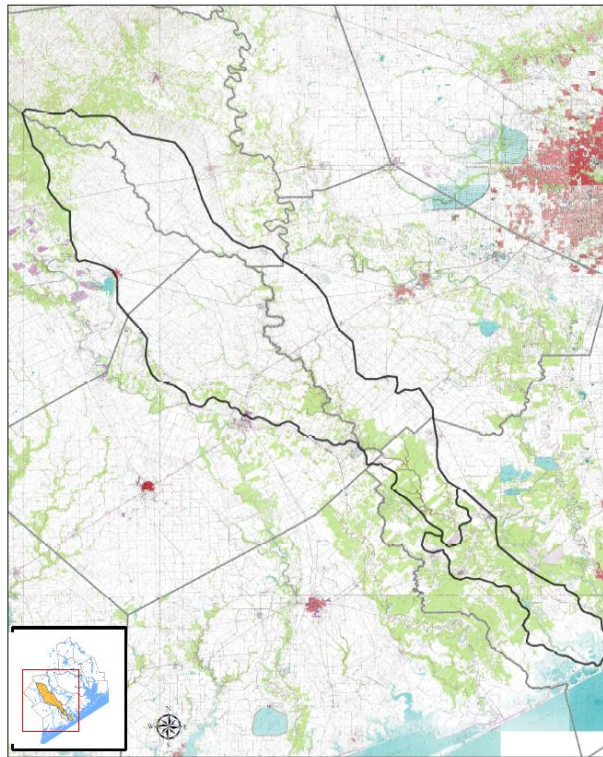


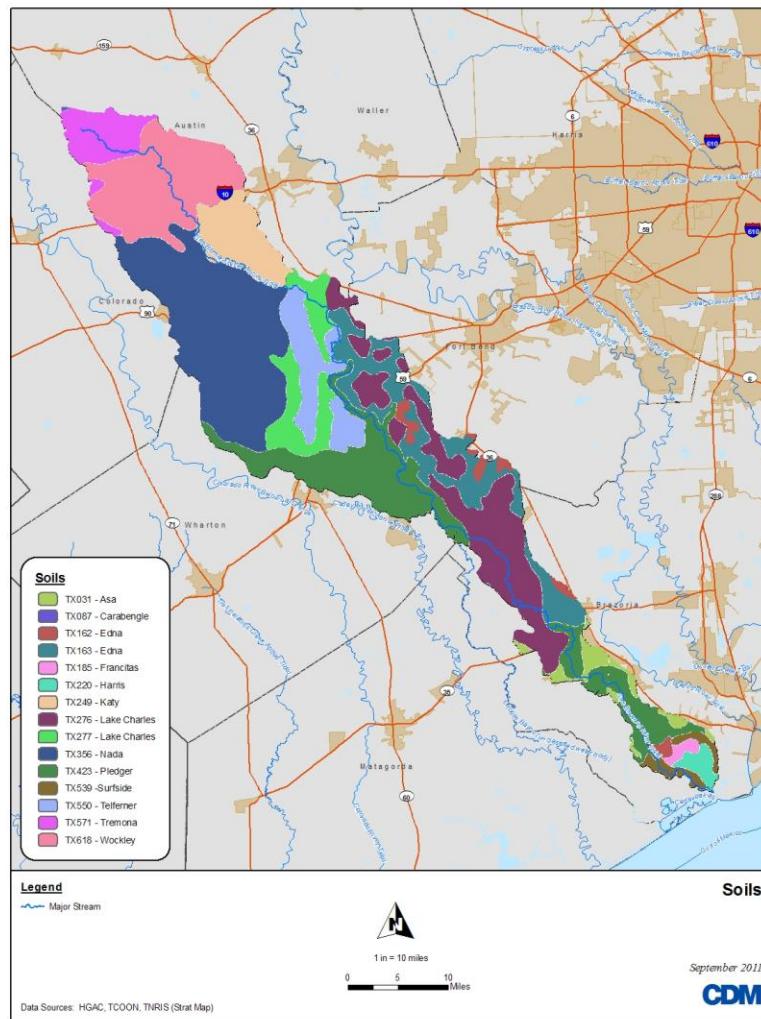
FIGURE 2 - SAN BERNARD WATERSHED TOPOGRAPHY

## SOILS

Soils include sand and gravels, sandy clay and silt with local sand, mud and other fluvial deposits. In the lower portion of the watershed near the Gulf, soils are primarily clays ranging from saline to non-saline. The land is nearly level and poorly drained. The predominant soil type in the San Bernard Watershed is hydrologic soil type D, and there are some combinations of type A, B and C in the upper portion of the watershed in Austin and Colorado Counties.

The lower portion of Brazoria County is in the Gulf Coast Marsh Resource Area and is predominantly salty soils. Most of the soils in the county are clayey and loamy, dark in color and have very little slope. 82% of the county is deep, non-saline soils. The major soils in the county are: Aris, Asa, Bernard, Brazoria, Edna, Lake Charles, Norwood, and Pledger. The Asa and Norwood soils are loamy and well drained, but the remainder of the soils is more poorly drained and has very slowly permeable subsoil. These soils are good for agricultural uses – row crops and pastures, and perform best with a surface drainage system.

In Wharton County, soils range in slope from 1% to 8%, most are somewhat poorly drained, have moderate available water capacity, and have very low to moderately low permeability. Soil types include: Telferner fine sandy loam, Gladewater soils, Edna fine sandy loam, Hockley fine sandy loam, Fulshear-Kenney complex, and Bernard-Edna complex.



## CLIMATE

Average annual rainfall in the area is between 40" to 54" with increasing levels towards the coast. The portion of the watershed along the coast is characterized by rainfall throughout the year with 60% falling between April and September. Average annual rainfall along the coast is 52 inches. There are a few rain gauges located throughout the watershed at the Atwater Prairie Chicken refuge, the City of Wharton, and at East Bernard.

Weather data for the simulation was collected from five weather stations in and around the San Bernard Watershed: Brenham, Bellville, Wharton, Wharton Airport, and Freeport. Specific information on each type of weather data is provided in more detail subsequently.

Although precipitation data were collected from the five stations noted previously, three stations (Bellville, Wharton, and Freeport) are located closest to the watershed. Therefore, data from these three stations were used preferentially to generate most of the precipitation input for SWAT. If there were gaps in the data during the simulation period the other two stations were used to complete these gaps. During the review of the weather data, one key discrepancy was noted for the precipitation data collected for Wharton County. One value noted on July 27, 2008 was noted to have a total of 13.98

inches of rainfall occurring but it could not be verified with other data sources such as NOAA, nearby weather stations. As such, it was removed from the rainfall dataset.

## WILDLIFE AND HABITAT

There are three designated wildlife and habitat areas in the San Bernard Watershed: the San Bernard National Wildlife Refuge, the Justin Hurst Wildlife Management Area, and the Attwater Prairie Chicken National Wildlife Refuge. There are also vast areas of open space throughout the watershed that are inhabited by wildlife.

Some of the birds found throughout the watershed include- gulls: Ring-billed, Laughing, Franklin’s, terns: Caspian, Forster’s, shorebirds: American Avocet, Willet, raptors: Red-Shouldered Hawk, Red-Tailed Hawk, Bald Eagle, Crested Caracara, Osprey, wading birds: Great Blue Heron, Great Egret, Snowy Egret, Little Blue Heron, other birds: Belted Kingfisher, American Pelican, Brown Pelican, Neotropical cormorant, Double-breasted cormorant, Snow Geese

Some of the other wildlife in the watershed include - fish: Redfish, Black minnows, Gar, speckled trout, flounder, blue catfish, mammals: White-Tail Deer, Raccoons, feral hogs, reptiles: Red-eared sliders, Water Moccasins (cottonmouths), diamond-back water snakes, shellfish: Oysters (beds), crabs.

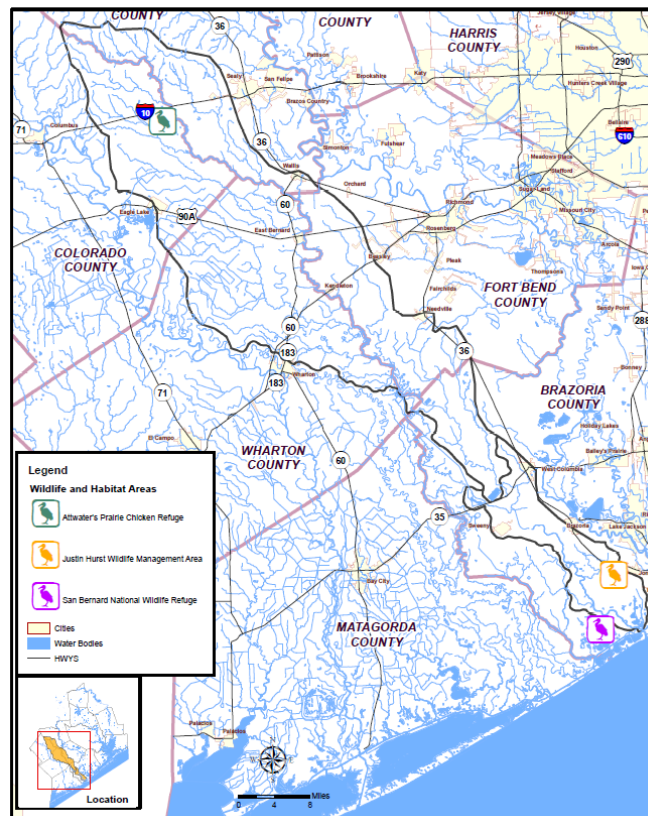


FIGURE 3 - WILDLIFE AND HABITAT AREAS IN THE SAN BERNARD WATERSHED

#### SAN BERNARD NATIONAL WILDLIFE REFUGE

The San Bernard National Wildlife Refuge is a 27,000 acre sanctuary established in 1968 to protect habitat for wintering waterfowl and estuarine systems for marine species. The United States Fish and Wildlife Service maintain the preserved land. Part of the refuge is open to the public for nature and wildlife viewing, and there are areas of permitted hunting on selected days throughout the year.

A portion of this refuge is in the southernmost part of the San Bernard watershed, and is an important coastal marsh wilderness and shelter for millions of migrating and nesting birds, including over 230 different species annually. Some of these include snow geese, warblers, herons, egrets, terns, and gulls, as well as neotropical bird species. The birds can be found in the marshy bottomlands, on several remote islands, or within the bottomland hardwood forests found throughout the refuge. Visitors may also see bobcats or alligators while touring the wildlife sanctuary. The refuge also supports estuaries that flourish with shell and fin fish and reefs of colonial oysters, supplying a feeding ground for adult fish and crabs.

#### JUSTIN HURST WILDLIFE MANAGEMENT AREA

Justin Hurst Wildlife Management area (formerly The Peach Point Wildlife Management Area) is another coastal preserve found in the southernmost portion of the San Bernard River watershed. The land, acquired between 1985 and 1988, is dedicated to sound biological conservation of all wildlife resources for the public's benefit. The WMA, managed by the Texas Parks and Wildlife Department, contains over 10,000 acres of coastal prairie and marshes and is part of the Central Coast Wetlands Ecosystem Project (CCWEP).

The CCWEP aims to create and maintain habitat for indigenous and migratory species, particularly waterfowl. Research activities are prevalent throughout the WMA, with resulting information concerning the understanding of coastal ecosystems distributed to scientists, land managers, resource agencies, and other interested parties. Currently, researchers are studying small mammals, snakes, and vegetation within the WMA. In addition, researchers assist in bird banding, which provides data for the Monitoring Avian Productivity and Survivorship Program.

The San Bernard National Wildlife Refuge and the Justin Hurst Wildlife Management Area serve important functions in the conservation of native vegetation and migrating wildlife and in the understanding of coastal ecosystems. These sanctuaries not only provide important information to scientists and the public, but they also provide recreational opportunities for locals and tourists as well as economic benefits to the region.

#### ATTWATER'S PRAIRIE CHICKEN NATIONAL WILDLIFE REFUGE

The Attwater's Prairie Chicken National Wildlife Refuge is located near Eagle Lake. Today it includes about 10,000 acres of protected habitat. In 1983, the US Fish and Wildlife Service formed the Attwater's Prairie Chicken Recovery Team to carry out science-based efforts to help save the birds. As of 2009, 90 birds inhabit three reserve sites, but recovery efforts are still underway.

#### IN THE CENTRAL PORTION OF THE WATERSHED

Baldcypress wetlands, and green ash and water hickory trees dominate the landscapes in the southern half of the San Bernard area while green ash and water oak are the predominate woody species in the northern half of the San Bernard study area and the Middle Bernard Creek area. Where present, yaupon holly and Chinese privet dominate the understory layer with a dense herbaceous layer throughout the area. Vegetation within the areas can be classified as riparian, early-mid successional vegetation. The

vegetation consists of a moderately dense overstory with the tree canopy averaging 60 feet in height, a moderately dense understory, and a dense herbaceous layer.



#### IN THE TIDAL PORTION OF THE WATERSHED NEAR THE MOUTH

The lower portion of the watershed is located in the Texan Biotic Province, an area which supports a wide variety of animals. The San Bernard River area provides feeding and nesting habitat for a large number of species of waterfowl, shore, and migratory birds traversing the Mississippi or Central Flyways. The bays and marshes contain shore and wading birds. Marshes and pasturelands in the area provide food and habitat for the other wildlife in the area. The beaches in the project area provide habitat for nesting sea turtles and are designated as critical habitat for the threatened piping plover.



## LAND USE AND POPULATION CHARACTERISTICS

### LAND USE AND LAND COVER

Much of the land throughout the watershed is used for crop production and cattle grazing, and the river is used for boating and fishing. Today, small towns among vast open spaces, with no major metropolitan area, characterize the watershed. The major agribusiness types in the watershed are beef cattle grazing and hay production. The counties in the northern and west central portions of the San Bernard River watershed are among the top cattle/ calf producers in the state. Other common crops found throughout the watershed include rice, sorghum, corn, cotton, and soybeans. Land uses in the watershed are primarily rural and agricultural, with scattered areas of urbanization, in the lower part of the watershed there is a lot of barge traffic associated with the natural resource industry.

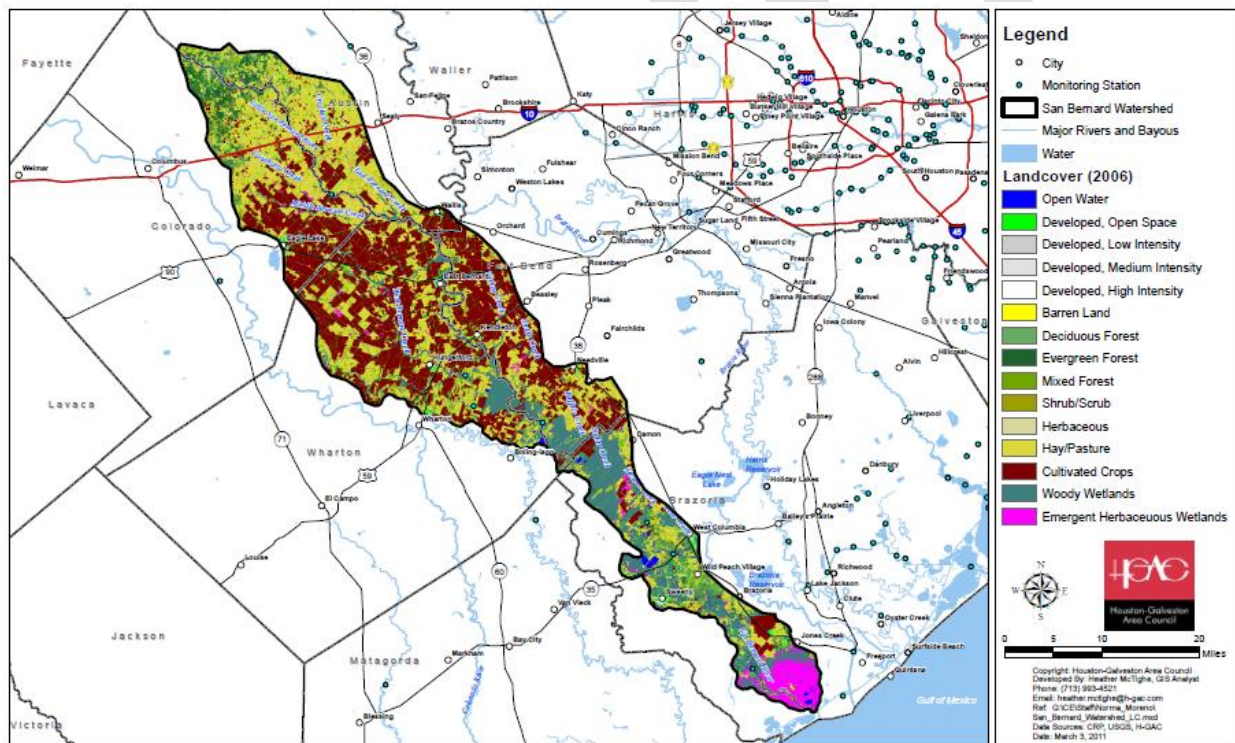
Minerals are another major natural resource found within the area. Oil, gas, sulfur, and salt are abundant subsurface features. Petrochemical services are another facet of the economy. Of particular geological significance, Boling Dome is situated on the western bank of the San Bernard River, in the easternmost part of Wharton County, near Boling-Lago. This subsurface structure contains petroleum, sulfur, and salt. The associated sulfur reserve has produced more sulfur than any other mine in the world. As of 1990, 80.5 million tons of sulfur had been removed, along with over 6,000 million cubic feet of natural gas, and over 25,500,000 barrels of oil. (Basin Highlights Report, H-GAC)

Conoco-Phillips has a refinery located in Sweeny that contains a natural gas liquid processing center and petrochemical production facilities. The plant uses the river to transport tankers from the plant in Sweeny to the Port of Freeport. Products produced include gasoline, jet fuel, and diesel fuel.

**TABLE 1- LAND USES IN THE SAN BERNARD WATERSHED 2006**

	2006 National Land Cover Dataset	Percent of Total
Developed	33,048	5.7%
Cultivated	209,198	35.8%
Grassland	185,863	31.8%
Forest	45,394	7.8%
Woody Wetland	84,292	14.4%
Herbaceous Wetland	21,344	3.7%
Bare	1,303	0.2%
Open Water	4,194	0.7%
<b>TOTAL ACRES</b>	<b>584,634</b>	<b>100%</b>

Much of the lower part of the watershed is wetlands and forest with residential uses along the waterways, the central part of the watershed is barren land and cultivated lands, and the upper part of the watershed is barren land and forest.



**FIGURE 4 - LAND USES IN THE SAN BERNARD WATERSHED 2006**

## EXISTING LAND MANAGEMENT PRACTICES

The Texas State Soil and Water Conservation Board has 152 Water Quality Management Plans in the San Bernard Watershed. These WQMPs are site-specific plans that are developed and approved by soil and water conservation districts to include appropriate land treatment practices, production practices, management measures, technologies or combinations of these. The purpose of these plans is to achieve water pollution prevention and to be consistent with state water quality standards. These plans do not cost anything to develop, but there are costs associated with implementation of practices to improve water quality, and there is financial assistance available.

Types of plans that have already been implemented in the San Bernard Watershed include: prescribed grazing, nutrient management, crop residue management, irrigation water management, forage harvest management, and pest management. The acreage in the San Bernard Watershed under a water quality management plan is 64,383 acres and the total acreage is 680,435, so approximately 9% of the watershed is under a plan currently. Below is a table showing the percentage of acreage under each type of management measure.

Management Measure	Acres	Percent of Watershed
Prescribed Grazing	31,698	4.7%
Nutrient Management	46,444	6.8%
Crop Residue Management/ Conservation Crop Rotation	29,304	4.3%
Forage Harvest Management	2,846	0.4%
Wildlife Land	9,456	1.4%

FIGURE 5 – MANAGEMENT MEASURES IN THE SAN BERNARD WATERSHED

## POPULATION GROWTH

The household population growth was generated for the watershed by the H-GAC. Growth was forecast for urban and rural areas over a thirty year period in 5 year increments. The total population of the watershed is expected to more than double in the next thirty years. It is expected that the majority of the new population growth will be in cultivated and grassland areas (80%) and in forest and wetland areas (20%). As the population in the watershed grows, it is expected that bacteria concentrations associated with urban and residential uses such as on-site sewage facilities and pets will continue to increase as rural sources like livestock sources will decrease.

Year	2010	2015	2020	2025	2030	2035	2040
Total Population	19,588	20,927	23,594	27,174	32,518	39,207	45,746

## BIOLOGY

A recent water quality and biological study conducted by the United States Geological Survey (USGS; East and Hogan, 2003) on the San Bernard River found that fish diversity and numbers decreased as they sampled down river. The study reports only seven species including longnose gar (*Lepisosteus osseus*), channel catfish (*Ictalurus punctatus*), longear sunfish (*Lepomis megalotis*), freshwater drum (*Aplodinotus grunniens*), blackstripe topminnow (*Fundulus notatus*), blacktail shiner (*Cyprinella*

venusta), and red shiner (*Cyprinella lutrensis*) from a collection station at West Columbia, approximately 25 miles upstream, from a list of 32 fish species found in the river at all sampling locations. With the near total closure of the mouth of the river and minimal flow or tidal exchange, it is assumed that the river supports a diverse fish population of more salt tolerant species.

## GEOMORPHOLOGY

This very active coastal area has undergone significant change over the last 80 years, due in large part to impacts to coastal sediment budget resulting from the development of the Port of Freeport and the dredging of the GIWW. The diversion of the Brazos River for port development resulted in a significant increase in the amount of sediment transported southward to the San Bernard River area, while the GIWW provides a channel available to “capture” flow from the impeded river, further reducing the current necessary to keep the mouth of the river open. Apparently unaware of the 2002 ERDC report (Kraus, 2002), TPWD’s Coastal Fisheries Division evaluated the blockage of the river’s mouth in 2004 in an attempt to determine the potential impact of the GIWW on the lower river (Chen and Buzan, 2004). Although their study was inconclusive as to the influence of the GIWW on the river, Chen and Buzan document that the mouth migrated from its 1974 location (the approximate location proposed for its restoration in this project), over 1.3 miles to the southwest by 2002. The 1974 location of the river’s mouth is now blanketed by a substantial sand spit that was dredged through in this current restoration effort.

## ADDITIONAL DATA NEEDED FOR MODELING

To complete in-stream modeling, additional cross sectional data is needed along the San Bernard River. Data has been requested from the LCRA and TCEQ for the San Bernard River at East Bernard. Bathymetric data has also been requested from the United States Army Corps of Engineers (USACE).

Assumptions have been made regarding *E. coli* levels in effluent from WWTPs in the watershed. Currently we do not have any data for these outfalls, so it is being assumed that they are releasing effluent that is within the current standards. We are trying to obtain data from outfalls in similar watersheds that do have current data.

Rainfall data is also being collected for the watershed. LCRA has a gauge in Wharton, and we have requested historical data for this gauge.

## SOURCES OF INFORMATION

USGS in Cooperation with the Houston-Galveston Area Council and the Texas Commission on Environmental Quality; Hydrologic, Water-Quality, and Biological Data for Three Water Bodies, Texas Gulf Coastal Plain, 2000-2002; Open File Report 03-459

2008 Texas 303(d) List, March 19, 2008, Texas Commission on Environmental Quality

US Army Corps of Engineers, Galveston District; Draft Environmental Assessment – Restoration of the Mouth of the San Bernard River to the Gulf of Mexico, Brazoria County, Texas, June 2008

Halff Associates, Inc; San Bernard Watershed Flood Protection Planning Study Final Report, July 15, 2009.