

**Briefing Paper on Lower Galveston Bay and Bayou Watersheds:  
Armand Bayou to Moses Lake and Adjacent Bay Waters**

Jim Lester, PhD. and Lisa Gonzalez

Houston Advanced Research Center

Galveston Bay Status and Trends Project

Funded by the TCEQ, Galveston Bay Estuary Program

July 2005

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**Description of the Watershed**

This subwatershed is bordered on the east at the I-45 causeway to Galveston Island and extends to the western edge of the Austin-Bastrop Bayou watershed in eastern Brazoria County. It is bordered on the south by the waters of West and Christmas Bays and extends north to the upper reaches of Chocolate Bayou. Highland and Mustang Bayous lie within the area. Alvin, Angleton and Santa Fe are the few municipalities in the subwatershed with populations of greater than 10,000 people. There is one small industrial complex on Chocolate Bayou. This subwatershed is the least developed area on the western side of Galveston Bay.

**Land Use and Habitat in the Watershed**

The area is not highly developed and has a single area of industrial land use on Chocolate Bayou. Commercial and residential land use is centered around Hitchcock, Alvin, Santa Fe and Angleton. Much of the land is agricultural. The most common agricultural uses are cattle grazing and rice farming. The Brazoria National Wildlife Refuge (NWR) is the largest parcel managed for conservation in the area.

This subwatershed has large areas of coastal prairie that are used for grazing. It has limited acreage that was historically forest. There are extensive marsh and brackish water wetland areas fringing the edges of the sub bays. Much of the prairie and associated wetland have been invaded by Chinese tallow tree, invasive grasses and fire ants. These invasives have excluded or preyed on native species and diminished the biodiversity in the area. Preserving or restoring the grassland is a major challenge.

The area contains important habitat for overwintering waterfowl species. It was part of the historical range of Atwater's prairie chicken and the whooping crane, but there are no current projects to restore these species in this area.

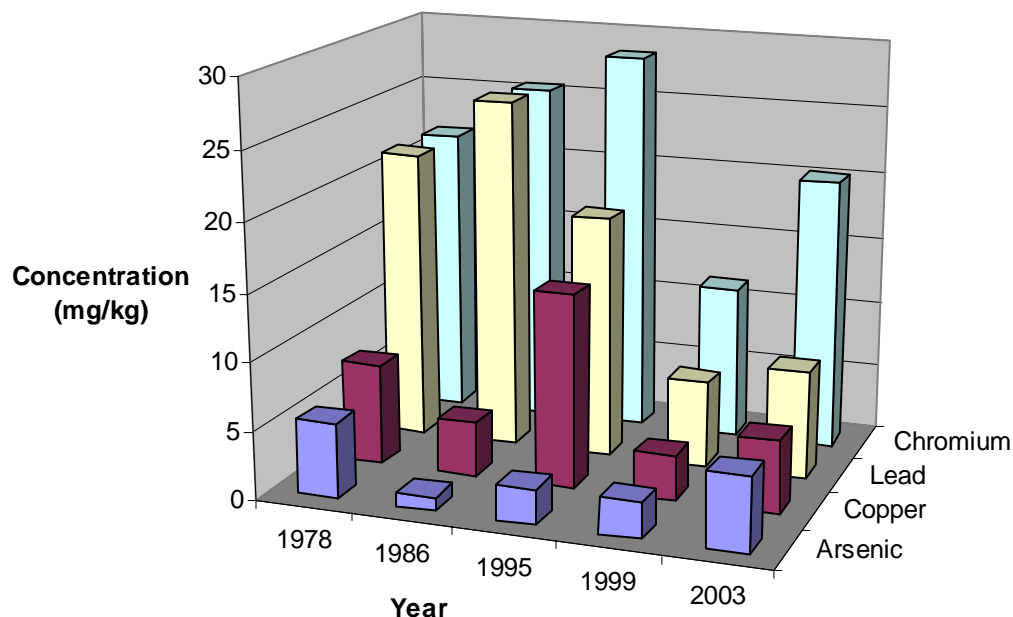
Christmas and Bastrop Bays remained as refuges for seagrass meadow habitat after the habitat type disappeared from West Bay. There is limited habitat restoration activity for marshes and seagrass meadows in and around Christmas and Bastrop Bays because the habitats are in better condition than in other parts of the Bay system. Christmas and Bastrop Bays are designated as a coastal preserve due to the quality of the water, sediment, habitat and abundance of wildlife.

## Water Quality Issues

Based on the available monitoring data there are few water quality problems in this subwatershed. Highland Bayou near Hitchcock is on the impaired water list because it has high bacteria concentrations and low dissolved oxygen in the headwaters. Chocolate Bayou, Mustang Bayou, Bastrop Bayou and Austin Bayou have not been cited for poor water quality. However, increasing development along the northern reaches of Bastrop Bayou could lead to degradation in water quality similar to the bayous near Dickinson and Clear Lake. The bays in this area are believed to have the best water quality in the Galveston Bay complex. Although there is insufficient monitoring data with which to make a definitive comparison.

There is an industrial complex located on Chocolate Bayou that discharges pollutants to the waters and over time has contributed to the accumulation of heavy metals in sediments of the bayou and bay. Relatively high concentrations in the sediments of Chocolate Bayou have been observed for arsenic, copper, chromium and lead. These sediments are not sampled every year. The figure below shows the observed concentrations for selected years over a 25 year period. The probable effects levels of these metals are considerably higher than the observed concentrations (Probable Effects Levels (PELS) for marine waters are as follows: arsenic = 41.6 mg/kg; copper = 108.2 mg/kg; chromium = 160.4 mg/kg; lead = 112.18 mg/kg).

Figure 1. Change over years in the concentration of metals in sediment samples taken near the Chocolate Bayou industrial area. Figure created by the Galveston Bay Status and Trends Project, Houston Advanced Research Center. Data source: Texas Commission on Environmental Quality.



Pollutants that occur episodically or at low levels can be monitored by measuring their bioaccumulation in the tissue of organisms living in the water. Monitoring fish for tissue contamination shows that samples taken from Christmas Bay have problems with contamination

by heavy metals. However, the levels are below the concentration required for a seafood consumption advisory. Samples of fish tissue collected by the Texas Department of State Health Services from West Bay in 1999 had elevated metal levels, but lower than the fish samples taken from Christmas Bay. This is the first assessment of seafood contamination in Christmas Bay, so there is no way of knowing when the problem began or whether the level of contamination is increasing or decreasing.

### Public Health Issues

Although there are no public beaches in this area and presumably very little swimming, these waters are used for boating, kayaking, wade fishing and water skiing. Participants in all of these activities could be at risk if there are high levels of bacteria indicating possible human pathogen contamination. Bastrop Bayou occasionally exceeds the screening level for coliform bacteria, and Chocolate Bayou has even lower levels on the average. The sub bays in this area only rarely have recorded bacteria levels exceeding the screening level set by TCEQ.

Table 1. Indicator describing the historical condition of fecal coliform bacteria in surface waters as a proportion of the TCEQ screening level. Refer to Table 2 for a description of the color system. Table created by the Galveston Bay Indicators Project, Houston Advanced Research Center. Data source: Texas Commission on Environmental Quality; Texas Department of State Health Services.

<b>SUBBAYS</b>	<b>1970s</b>	<b>1980s</b>	<b>1990s</b>	<b>2000s</b>
West Bay				
Christmas Bay				

<b>TRIBUTARIES</b>	<b>1970s</b>	<b>1980s</b>	<b>1990s</b>	<b>2000s</b>
Chocolate Bayou/Bay				
Bastrop Bayou				

Table 2. Indicator rating system developed for the monitoring data on fecal coliform bacteria concentration in surface waters. Table created by the Galveston Bay Indicators Project, Houston Advanced Research Center.

<b>Rating</b>	<b>Proportion of Samples Above Screening Level</b>
<b>Very Good</b>	0% samples above the screening level
<b>Good</b>	1-9% samples above the screening level
<b>Moderate</b>	10-25% samples above the screening level
<b>Poor</b>	>25% samples above the screening level

In other parts of the Lower Galveston Bay watershed, there are water bodies in which fish have been collected that were so heavily contaminated with organic compounds or metals that people have been advised not to consume them. No seafood advisory has been issued for waters in this subwatershed. The fish and crabs are considered safe to eat. The water around oyster reefs is also

monitored to support the regulation of harvest to protect human health. The majority of West Bay and Christmas Bay are approved for oyster harvest; however, the waters of West Bay from the Galveston Causeway to Greens Lake and all of the small embayments along the north shore of West Bay, i.e. Greens Lake, Carancahua Lake, Hall's Lake, Chocolate Bay, Oyster Lake, Lost Lake and Cox Lake, are restricted areas for shellfish harvesting.

### **Other Issues**

This area of the Lower Galveston Bay watershed is a major focus of conservation planning. There are major conservation land holdings on East Bay, Christmas Bay and Bastrop Bay, but only small parcels on the shores of Chocolate or West Bay. Conservation organizations, including The Nature Conservancy, have discussed the opportunity to purchase agricultural land on the north side of West Bay for restoration of coastal prairie and to better connect the large parcels of wildlife habitat preserved around Christmas Bay, north and south of Texas City, and on East Bay. This is an area that has been impacted less by human development than areas closer to the centers of industry and commerce.

### **Conclusion**

Both aquatic and terrestrial habitat in this area of the Galveston Bay watershed are in relatively better condition than other areas on the western side of Galveston Bay. Christmas and Bastrop Bays are designated as a Coastal Preserve because they retain more of the historical aquatic habitat than other portions of the Galveston Bay system. This subwatershed appears to be of significant value for the conservation of fish and wildlife resources. Water and sediment quality is generally very good although Highland Bayou is on the impaired waters list due to bacterial contamination and Bastrop Bayou occasionally exceeds criteria levels for fecal coliform bacteria. There is also some industrial contamination in portions of Chocolate Bayou. Fish and crabs from this area are considered safe to eat. The small lakes and embayments along the north shoreline of West Bay and Christmas Bay are restricted for shellfish harvest, but the majority of the waters in West Bay and all of Christmas and Bastrop Bays are approved areas for oyster harvest. The land and waters in this subwatershed show limited human impacts because there is little intensive development in the area.