2009 Mustang Island State Park Water Quality Report

Prepared by:

Texas Stream Team

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Much of the following introduction is taken directly from the TCEQ document entitled:

Texas Surface Water Quality: What Is It, and How Is It Measured?

In order to protect water quality, we must define and measure it. The state of Texas has established standards that protect the purposes for which the water bodies in the state will be used, and defined measurements that will assure the water quality is good enough to attain those uses. Based on the standards, the Texas Commission on Environmental Quality (TCEQ), in concert with other federal, regional, and local agencies, carries out a regular program of monitoring and assessment to determine which water bodies are meeting the standards set for their use, and which are not. The state produces a periodic report, the *Texas Water Quality Inventory and 303(d) List*, that compares water quality conditions to established standards, as required by federal Clean Water Act (CWA) Sections 305(b) and 303(d) (TCEQ 2005, 1).

Texas Surface Water Quality Standards

The *Texas Surface Water Quality Standards* are rules that:

- designate the uses, or purposes, for which the state's water bodies should be suitable;
- establish numerical and narrative goals for water quality throughout the state; and
- provide a basis on which TCEQ regulatory programs can establish reasonable methods to implement and attain the state's goals for water quality.

All standards are protective; that is, they signal a situation where there is some possibility that water quality may be inadequate to meet its designated uses. There are instances, for example, in which a water body fails to meet the dissolved oxygen criterion for attainment of the aquatic life use, yet the number and variety of species present are high, and no fish kills are observed (TCEQ 2005, 1).

Four general categories for water use are defined in the *Texas Surface Water Quality Standards*:

- aquatic life use
- contact recreation
- public water supply
- fish consumption

Aquatic Life Use

The standards associated with this use are designed to protect aquatic species. They establish optimal conditions for the support of aquatic life and define indicators used to measure whether these conditions are met. Some pollutants or conditions that may violate this standard include low levels of dissolved oxygen, or toxics such as metals or pesticides dissolved in water (TCEQ 2005, 1).

Contact Recreation

The standard associated with this use measures the level of certain bacteria in water to estimate the relative risk of swimming or other water sports involving direct contact with the water. It is possible to swim in water that does not meet this standard without becoming ill; however, the probability of becoming ill is higher than it would be if bacteria levels were lower (TCEQ 2005, 1).

Public Water Supply

Standards associated with this use indicate whether water from a lake or river is suitable for use as a source for a public water supply system. Source water is treated before it is delivered to the tap. A separate set of standards governs treated drinking water. Indicators used to measure the safety or usability of surface water bodies as a source for drinking water include the presence or absence of substances such as metals or pesticides. Concentrations of salts, such as sulfate or chloride, are also measured, since treatment to remove high levels of salts from drinking water may be expensive (TCEQ 2005, 2).

Fish Consumption (fresh water and salt water)

The standards associated with this use are designed to protect the public from consuming fish or shellfish that may be contaminated by pollutants in the water. The standards identify levels at which there is a significant risk that certain toxic substances dissolved in water may accumulate in the tissue of aquatic species. Because toxic substances in water may exceed these levels while no accumulation in fish tissue is observable, the state conducts tests on fish and shellfish tissue to determine if there is a risk to the public from consuming fish caught in state waters. The standards also specify bacterial levels in marine waters to assure that oysters or other shellfish subject to commercial harvest and marketing are safe for public sale and consumption (TCEQ 2005, 2).

Indicators of water quality that are not tied to specific uses—such as dissolved solids, nutrients, and toxic substances in sediment—are also described in the standards. Indicators of water quality are discussed in more detail later in this document. A complete copy of the *Texas Surface Water Quality Standards* is available from the TCEQ Publications Library at 512/239-0028, or on the TCEQ Web site at www.tceq.state.tx.us/permitting/water_quality/wq_assessment/standards/WQ_standards_intro.html (TCEQ 2005, 2).

Texas Water Quality Inventory and 303(d) List

The *Texas Water Quality Inventory and 303(d) List* is an overview of the status of surface waters of the state, including concerns for public health, fitness for use by aquatic species and other wildlife, and specific pollutants and their possible sources. More than 700 water bodies are assessed in Texas.

The 303(d) List, a subset of the Inventory, identifies:

- water bodies that do not attain one or more of the standards set for their use, or are expected not to meet one or more uses in the near future;
- which pollutants or conditions are responsible for the failure of a water body to attain standards;

Common limitations in water quality include:

- bacteria levels that exceed the criterion established to assure the safety of contact recreation
- dissolved oxygen levels that are lower than the criterion established to assure optimum conditions for aquatic life
- total dissolved solids, sulfate, and chloride that exceed the criteria established to safeguard general water quality uses
- contaminants in fish tissue that pose a risk to consumers

Some water bodies also have:

- toxic substances in water that exceed the criterion to protect aquatic life
- conditions of acidity (measured as pH) and high temperature that exceed the criteria to safeguard general water quality uses

The *Texas Water Quality Inventory and 303(d) List* is available on the TCEQ Web site at www.tceq.state.tx.us/compliance/monitoring/water/quality/data/wqm/305_303.html (TCEQ 2005, 2-3).

Indicators of Water Quality

Several different parameters are measured to determine whether a water body meets the standards for its use. Some of the most common are listed here, with an explanation of why they are important to the health of a water body (TCEQ 2005, 3). At least ten samples from the last seven years with approximately the same interval between sample times are required for a water body to be listed on the 303(d) list. At a minimum, they must be taken every two years with no more than 2/3 of samples taken any one year and no more than 1/3 taken from any one season (Surface 2008, 29).

Metals

High concentrations of metals such as cadmium, mercury, and lead pose a threat to drinking water supplies and human health. Eating fish contaminated with metals can cause these toxic substances to accumulate in human tissue, posing a significant health threat. Metals also pose a threat to livestock and aquatic life. Potentially dangerous levels of metals and other toxic substances are identified through chemical analysis of water, sediment, and fish tissue (TCEQ 2005, 3).

Organics

Toxic substances from pesticides and industrial chemicals, called organics, pose the same concerns as metals. Polychlorinated biphenyls (PCBs), for example, are industrial chemicals that are toxic and probably carcinogenic. Although banned in the United States in 1977, PCBs remain in the environment, and they accumulate in fish and human tissues when consumed (TCEQ 2005, 3).

Bacteria

E. coli and Enterococci bacteria are measured to determine the relative risk of swimming (contact recreation), depending on whether the water body is fresh or marine. Enterococci is measured for the bodies of water covered in this report. These bacteria originate from the wastes of warm-blooded animals. The presence of these bacteria indicates that associated pathogens from these wastes may be reaching a body of water. Sources may include inadequately treated sewage, improperly managed animal waste from livestock, pets in urban areas, aquatic birds and mammals, or failing septic systems (TCEQ 2005, 3). A maximum of 89 colony forming units (cfu) per 100 mL of Enterococci bacteria for single grab samples and a geometric mean of 35 cfu/100mL are the state standards for the water bodies around Mustang Island State Park. This must be

exceeded 25% of the time or more for a body of water to be considered impaired (Surface 2008, 68-69).

Dissolved Oxygen

Oxygen is necessary for the survival of most organisms. Too little oxygen will lead to asphyxiation of aquatic organisms. Too much oxygen (supersaturation) can cause bubbles to develop in cardiovascular systems, which could be fatal. Dissolved oxygen levels below 2 mg/L will lead to asphyxiation, and levels above 20 mg/L will lead to supersaturation. Low dissolved oxygen levels typically result from abundance of nutrients, the process of which was described in the previous section. They may also result from high groundwater inflows as groundwater is typically low in dissolved oxygen due to minimal aeration or high temperatures which reduce oxygen solubility. A problem frequently related to dissolved oxygen concentrations is an excess of nutrients in water. Large quantities of nutrients in water can cause excessive growth of vegetation on the surface. This excessive vegetation, in turn, can cause low dissolved oxygen because of limited photosynthesis for subsurface vegetation. This process is known as eutrophication. The acceptable levels of dissolved oxygen depend on the characteristics of the water body (TCEQ 2005, 3). A minimum of 2 mg/L and an average of 3 mg/L must be met 90% of the time for the water around Mustang Island State Park for it not to be listed on the 303(d) list (Surface 2008, 48 & Surface 2008, 170).

Dissolved Solids

High levels of dissolved solids such as chloride and sulfate can cause water to be unusable, or simply too costly to treat for drinking water uses. Changes in dissolved solids concentrations also affect the quality of habitat for aquatic life (TCEQ 2005, 3).

Fish Consumption Advisories and Closures

The Texas Department of State Health Services (DSHS) conducts chemical testing of fish tissue to determine whether there is a risk to human health from consuming fish or shellfish caught in Texas streams, lakes, and bays. Fish seldom contain levels of contaminants high enough to cause an imminent threat to human health, even to someone who eats fish regularly. However, risk increases for people who regularly consume larger fish and predatory fish from the same area of contaminated water over a long period of time. To reduce health risks in areas of contamination, people should eat smaller fish from a variety of water bodies. When a fish consumption advisory is issued, a person may legally take fish or shellfish from the water body under advisory, but it is not

recommended. When a fish consumption closure is issued for a water body, the taking of fish or shellfish is legally prohibited (TCEQ 2005, 4).

Fish Consumption Advisories

Fish advisories may warn against the consumption of particular fish or shellfish species from the affected water body, or may recommend the amount of fish that may be consumed over certain periods of time by specific segments of the population. For example, an advisory may read:

"Consumption Advice:
The advisory includes all species of fish and recommends limiting consumption to the following:
1. Adults should consume no more than one meal, not to exceed 8 ounces of fish per serving, each week.
2. Children seven years of age and older should consume no more than one meal, not to exceed 4 ounces of fish per serving, each week.
3. Children 6 and under, pregnant women, or women who may soon become pregnant should not consume fish from this reservoir.
4. Persons consuming fish from this reservoir should not consume mineral dietary supplements with selenium exceeding 50 micrograms per day" (TCEQ 2005, 4)

Fish Consumption Closures

Fish consumption closures identify a specific water body, or portion of a water body, where the taking of fish is prohibited because the human health risk from fish consumption is very high. The closure notice will also identify the contaminant of concern, such as mercury or fecal coliform bacteria, and will list any (or all) species of fish or shellfish which people are prohibited from taking from the area of closure (TCEQ 2005, 4).

Water Quality in Area Bays and Gulf

The entire Coastal Bend bay system has been designated as an "Estuary of National Significance" by the Environmental Protection Agency due to its ecological and economic importance. This area contributed almost $760 million to the local economy and $1.3 billion statewide when a study was conducted in 1987. Corpus Christi Bay is home to the country's sixth largest port and third largest refinery and petrochemical complex. It has the fourth largest amount of agriculture for estuaries in the U.S, and there are over 2600 documented species of plants and animals with over 400 bird species living in or migrating through annually (Quenzer and others 1998, 6).

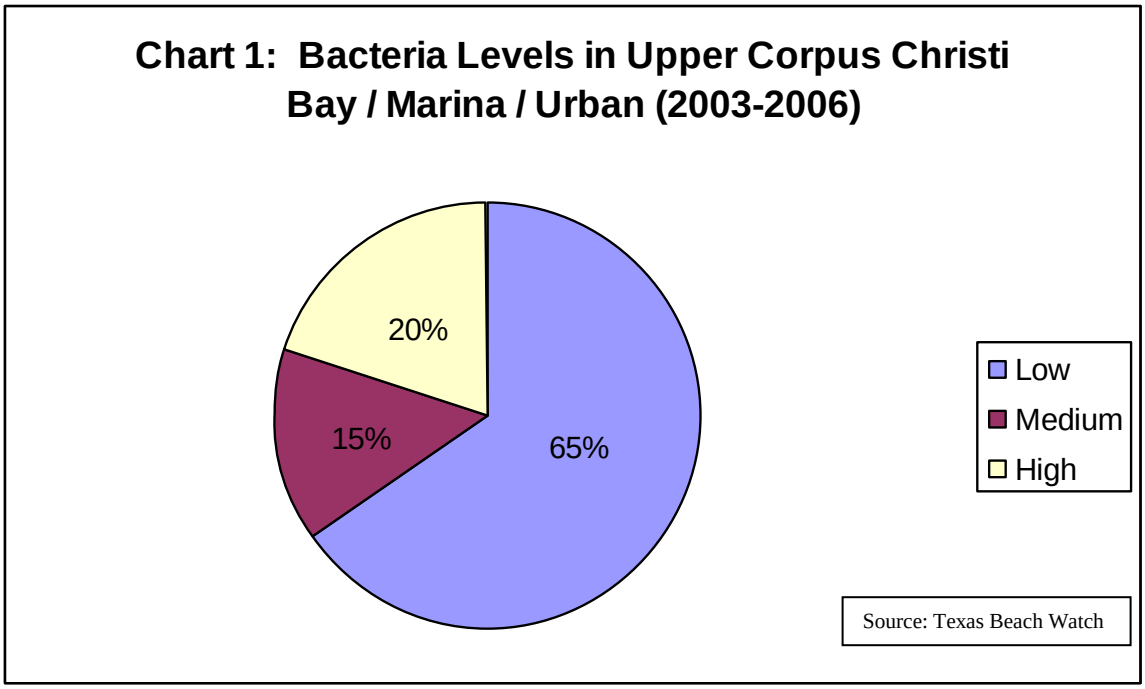
The following data spans from 1999-2008. General use, Aquatic life use, oyster waters use, contact recreation, and fish consumption use were all monitored. However, fish consumption monitoring has only occurred since 2006. When an impairment is not listed, there is no concern for use in that body of water.

Corpus Christi Bay

The Corpus Christi Bay system is 192 square miles. Freshwater inflow comes from the Nueces River and Oso Creek and mixes with saline water from the Gulf at Aransas Pass. The bay is home to more than 490 species of birds and 234 species of fish, is surrounded predominately by agriculture and ranches, and borders Corpus Christi and Ingleside (Nipper, Chavez and Tunnel Jr. 2009, 1).

Currently Corpus Christi Bay is not considered impaired under state regulations. However, freshwater inflow is very low due to reservoir construction, increased population, and industrial growth in this already arid region. This has contributed to salinization of the delta and shoreline erosion. There has also been extensive commercial fishing which causes an excess loss of non-targeted species (TPWD 2008, 3).

There have been 18 days Mustang Island beaches were closed due to high bacteria levels threatening contact recreation between 2003 and 2008 (EPA 2009a, 1). Between 2003 and 2006 20% of the 1,399 Enterococci bacteria counts were high and 15% were medium (see Chart 1) (TCEQ 2008a, 14). Medium counts are between 35 and 104 cfu/mL and high counts are above 104 cfu/mL. Beaches are closed for high counts (Texas 2009, 1). The state standard for Enterococcus bacteria in Corpus Christi Bay is 89 colony forming units per 100mL. This was exceeded 51 times between 2003 and 2008 on Mustang Island, or 2% of the total observations (See Appendix 1). Bacteria levels must exceed the criteria 25% of the time for the water body to be considered impaired (Surface 2008, 68-69).

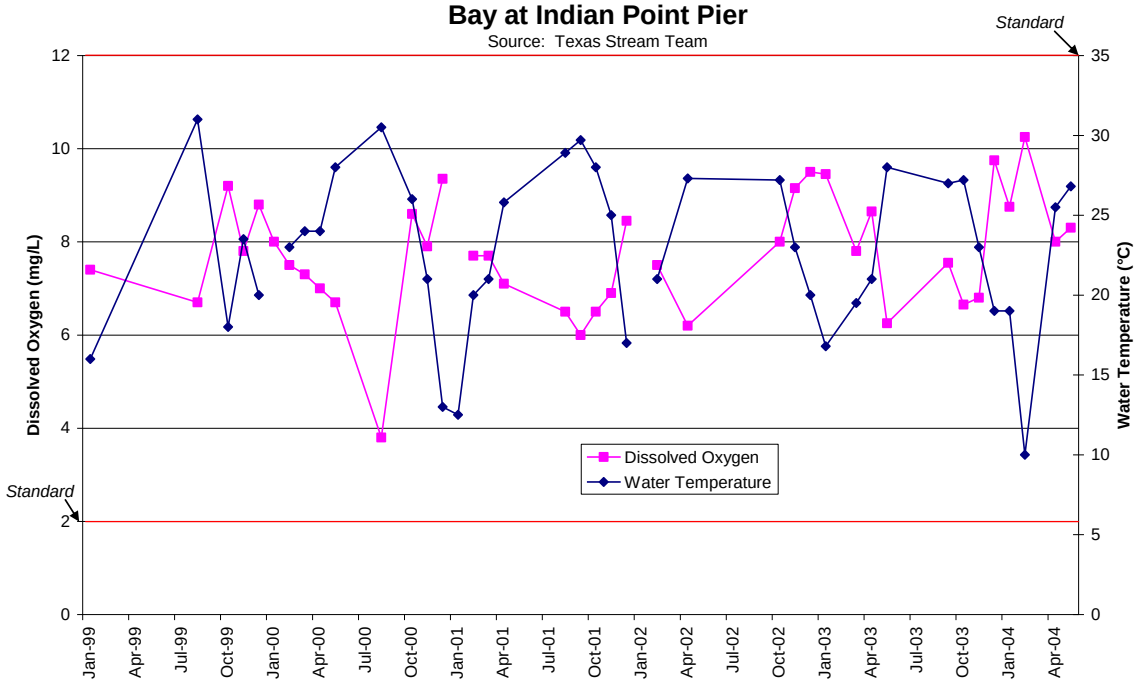


Ammonia, chlorophyll-a, and nitrates are listed in the 2008 Water Quality Inventory as concerns for screening levels in Corpus Christi Inner Harbor, which drains into the bay (TCEQ 2008b). Plants living on the surface of the water will thrive when a high amount of nutrients end up in the water, thus making it more difficult for plants under the surface to carry out photosynthesis, which adds oxygen to the water. This process, referred to as eutrophication, lowers the amount of dissolved oxygen. Low amounts of dissolved oxygen reduce species diversity, and if low enough, produce fish kills. Chlorophyll-a can cause adverse affects such as wide diurnal fluctuations of dissolved oxygen and depletion of dissolved oxygen near the bottom due to decomposition of dead algae (EPA 1993, 22). Nutrients like chlorophyll-a, typically come from sewage treatment plants, concentrated animal feeding operations, storm water runoff, and leaky septic tanks. Nitrates, which can come from fertilizers, also accelerate eutrophication, and can cause the aforementioned affects. If consumed, they affect the oxygen carrying capacity of blood, and can be particularly threatening to infants. Removal is expensive because it requires purchases of new technology (EPA 2009b, 1).

The following shows all available dissolved oxygen (D.O.) data for Corpus Christi Bay from 1999-2004 (Chart 2). This has been compiled from Texas Stream Team volunteer data. The desired maximum temperature level for Corpus Christi Bay is 35° C and can be seen as the top of the graph. This shows the dissolved oxygen level does not drop below the minimum allowed amount. It would have to exceed the criteria 10% of the time for this area to be considered impaired for human contact recreation use (Surface 2008, 170).

Chart 2: Dissolved Oxygen and Water Temperature for Corpus Christi Bay at Indian Point Pier

Source: Texas Stream Team



Corpus Christi Bay has been impaired in the past. In 1999, 6 sq. mi. near Corpus Christi did not support oyster water use. That area was restricted for growing and harvesting of shellfish for direct marketing because of possible contamination by pathogens. The TCEQ has listed the cause as non-point source pollution, or, contamination coming from so many sources across the land that it is impossible to pin-point all of them (TCEQ 1999, 33). There are 12 permitted industrial wastewater outfalls and 6 permitted domestic wastewater outfalls in the bay (Surface 2000, 89). These could have contributed to the high amount of pathogens.

Red tide is a naturally occurring algae that produces a toxin which can kill fish and cause respiratory irritation in humans. It is called red tide because when in high concentration, it turns the water red (TPWD 2009a, 1-2). On October 14, 2009, another red tide bloom killed around 1,000 fish. Since then, there have been many fish kills observed with the most recent being late December, 2009 (TPWD 2009b, 7). The Texas Department of State Health Services is in the process of monitoring fish tissue to determine whether or not the ban shellfish harvesting. In December 2001 a red tide in Corpus Christi Bay caused the Texas Department of Health to ban shellfish harvesting for nearly a year. There was another ban from September 1996 to January 1997 (TPWD 2002, 1).

Nueces Bay

Nueces Bay has an area of 28.9 square miles and drains the Nueces River Basin, portions of the San Antonio-Nueces and Nueces-Rio Grande Coastal Basins. It is a shallow bay that receives freshwater from the Nueces River and exchanges saline water with Corpus Christi Bay. It borders Corpus Christi, Uvalde, Pleasanton, George West, and Three Rivers. Economic activities in and around the bay include petrochemical refining and production, agriculture, manufacturing, recreation, maritime commerce, and tourism. Ecologically, it provides a home for many plants and animals and plays a role in water purification and storm protection (TCEQ 2009a, 1).

Nueces Bay is currently considered impaired under state regulations. The entire bay is impaired and has been listed as such since 1998. The growing or harvesting of shellfish is restricted due to zinc in the oyster tissue (TCEQ 2009b). In 2007, the TCEQ drafted an Implementation plan to describe the regulatory and voluntary actions needed to restore the use (TCEQ 2009a, 2). It focuses on maintaining loads from the controllable point sources by establishing a total maximum daily load (TMDL) (Chief 2006, 1).

Zinc is an element naturally present in human tissue which helps with metabolism, tissue repair, cell replication, and growth. However, it is toxic if consumed excessively over an extended period of time, causing a reduced absorption and utilization of copper and iron by the body (TCEQ 2009a, 1). TCEQ has identified non-point source and point sources including municipal and industrial permitted sources (Chief 2006, 1). There are two domestic wastewater outfalls and five industrial wastewater outfalls in this bay (TCEQ 2000, 543).

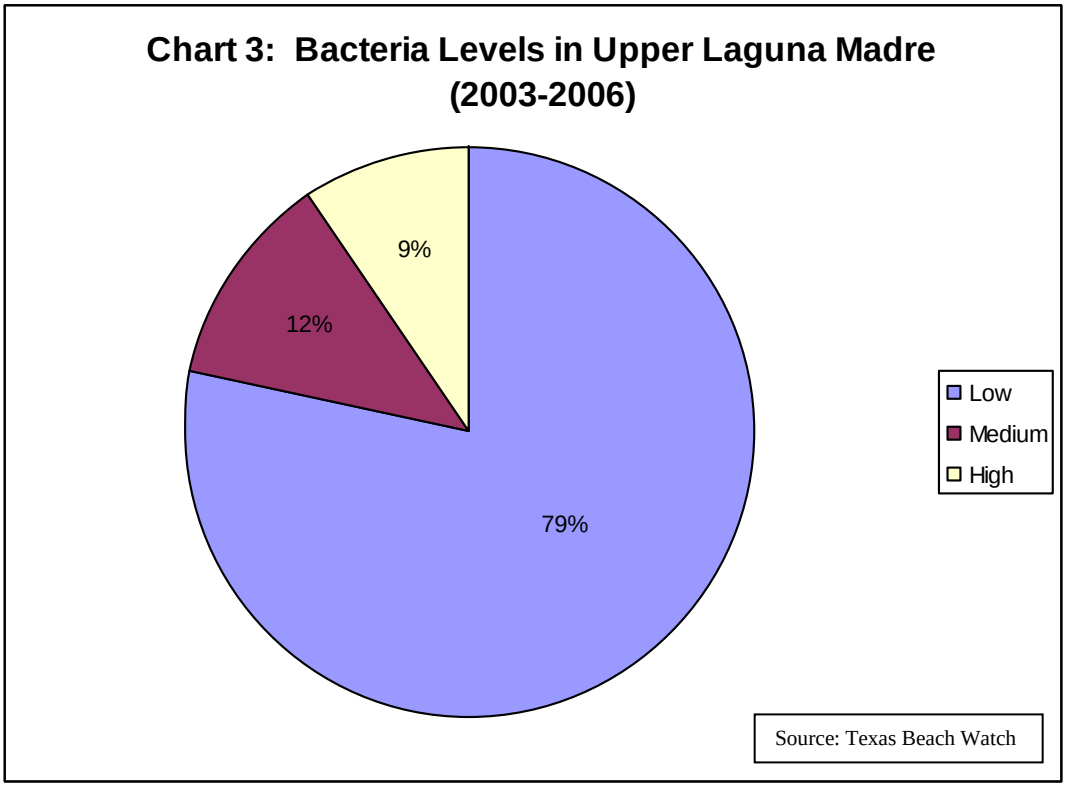
Upper Laguna Madre

Laguna Madre is one of five hypersaline estuaries in the world. It is a shallow, bar-built coastal lagoon with limited freshwater inflow, which is primarily attributed to municipal or industrial discharges and to runoff from rainfall events. It has a surface area at mean tide of 729 square miles. Ecologically, it exhibits barren shorelines with extensive wind-tidal flats, extensive submerged seagrass meadows, and a highly productive fin fishery (TCEQ 2009c, 1). It borders Corpus Christi, Port Mansfield, Laguna Vista, Laguna Heights, Port Isabel, and South Padre Island. Economic activities include ranching, oil and gas production, agriculture, fishing, recreation, and tourism (TCEQ 2009d, 1). This analysis will only focus on the upper portion near Mustang Island State park.

Upper Laguna Madre is currently not considered impaired under state regulations. However, Chlorophyll-a is listed in the 2008 Water Quality Inventory as concerns for screening levels (TCEQ 2008c, 133). TCEQ lists the source as urban runoff, municipal point source discharges, and irrigated crop production upstream (TCEQ 2008d, 228). There are three permitted agriculture wastewater outfalls, 43 permitted domestic

wastewater outfalls, and 17 permitted industrial wastewater outfalls bordering Laguna Madre (TCEQ 2000, 552).

There were 18 counts of high and 24 counts of medium Enterococci bacteria levels out of 193 total counts over 3 beaches. This equates to 9% having high and 12% having medium bacteria concentrations, accounting for 21% of total observations (Chart 3) (TCEQ 2008a, 14). Therefore, the Upper Laguna Madre is not impaired for bacteria.



Upper Laguna Madre has been impaired in the past. The upper portion of the bay near Laguna Madre was first listed on the 303(d) list in 1999 for low dissolved oxygen (TCEQ 1999, 33). However, in 2001 the TCEQ realized relatively shallow, high salinity bays such as the Laguna Madre tend to show low DO levels, but the organisms are well adapted. Therefore, low DO levels applicable to other water bodies in Texas are not applicable to this one. The TCEQ decided that more appropriate standards are necessary for Laguna Madre (Nicolau 2005, 20). In June 2002, the TCEQ decided 24-hour monitoring was necessary to determine whether the oxygen criteria should be adjusted. In November of 2002, additional monitoring began and since then, site specific standards have been proposed (TCEQ 2009d, 2).

Redfish Bay

Redfish Bay extends five miles along the Texas coast and has fifty square miles of prime fishing habitat. It has 14,000 acres of submerged seagrass, mostly turtle grass and shoal grass (Handbook 2008, 1 & TPWD 2007, 1). It borders Rockport, Aransas Pass, Port Aransas, and Ingleside.

Redfish Bay is considered impaired under state regulations. It has been on the 303(d) list since 2006 for bacteria in oyster waters. A TMDL is planned to begin soon (TCEQ 2009b). TCEQ lists the source as urban runoff (TCEQ 2008d, 226-227). In 2002, dissolved oxygen levels were close to standard but not in exceedance (TCEQ 2002, 1).

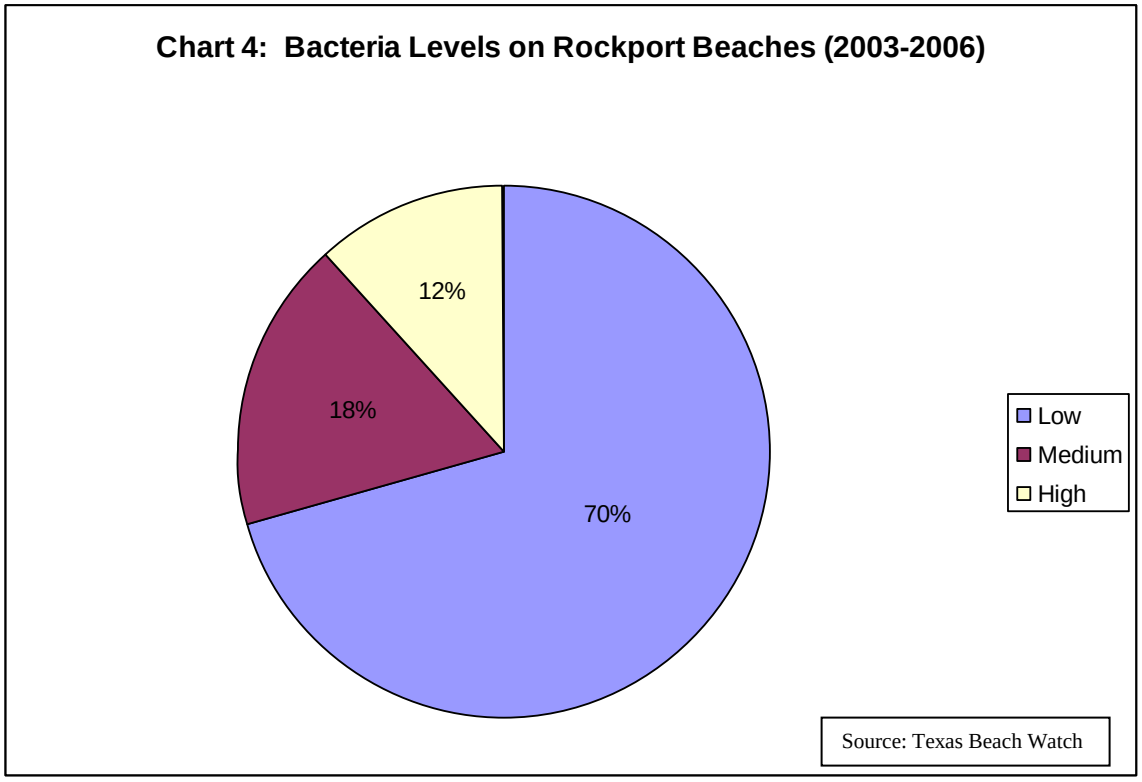
Aransas Bay

Aransas Bay is 208 square miles and is located between Corpus Christi Bay and San Antonio Bay. Freshwater inflows, while minimal, come from the Aransas River, Mission River, and Copano Creek. Land use around the bay is primarily agriculture and ranching, with minimal urban development. The Aransas National Wildlife Refuge, which borders Rockport and Fulton, is comprised mostly of coastal prairie and marshlands.

Aransas Bay is currently not impaired under state regulations. However, it supports extensive commercial fishing, which can threaten the health of the bay. Freshwater inflow is often inadequate to support the rich species diversity of the area. Also, the Texas Department of Health has closed the shoreline area to all shell fishing because of inadequate sewage treatment (TPWD 2008, 1).

Aransas Bay has been impaired in the past. In 1999, it was on the 303(d) list for bacteria in oyster waters along the northern edge of the bay near Rockport when 7.8% of the bay was considered impaired (TCEQ 1999, 32). It was then delisted in 2002 while still showing a "use concern." Since 2006, there has not been a concern. The exceedingly high bacteria levels in the past could have been attributed to the five permitted domestic dischargers on the bay.

Four Rockport beaches were monitored and 18% of the observations had medium levels of bacteria, while 12% had high levels (Chart 5) (TCEQ 2008a, 14). Therefore, Aransas Bay does not appear to be impaired.



Copano Bay / Port Bay / Mission Bay

The Copano Bay watershed drains a 2,652 square mile area of coastal plains between the San Antonio and Nueces Rivers. The primary sources of freshwater in this area are the Mission River and the Aransas River. It borders Rockport, Refugio, Sinton, Taft, and Bayside and is home to a diverse group of flora and fauna including shrimp, crap, and oysters sought after by commercial fishermen and recreational anglers (TCEQ 2009e, 1).

Copano Bay, Port Bay, and Mission Bay are currently impaired under state regulations. A TMDL began in September 2003 in response to high bacteria levels, specifically along the southern shore including Port Bay, and the area near Bayside (TCEQ 2009e, 2). Testing done by the TCEQ at 14 stations in the bay has shown the cause to be leaking human sewage and livestock (mostly cows and horses), with minimal contributions from wildlife and gulls (Mott & Lehman 2005, 3).

Mission Bay and Port Bay were first placed on the 303(d) list for bacteria in oyster waters in 1998 (TCEQ 2008e, 115). 20.6% of the bay did not support oyster harvesting at the time, mostly near the Intracoastal Waterway, shoreline, and Aransas/Mission Rivers (TCEQ 1998, 20). In 2002, dissolved oxygen levels near Rockport were near exceedance, and there was a nutrient enrichment concern near Bayside (TCEQ 2002). By 2006, they were fully supporting for aquatic life use (TCEQ 2006a, 110).

Gulf of Mexico

The Gulf of Mexico is currently considered impaired under state regulations. It was first listed in 1998 for mercury contamination from the shoreline to the limit of Texas jurisdiction between Sabine Pass and the Rio Grande (TCEQ 2008e, 117). The entire gulf is under advisory for consumption of King Mackerel for the amount of mercury in fish tissue. The Texas Department of Health advises that consumption of fish between 37 inches and 43 inches in total length to be limited to no more than one 8 ounce meal per week. Women of childbearing age and children under twelve years of age should limit consumption to no more than one meal per month. King mackerel measuring over 43 inches should be avoided, while those fewer than 37 inches are safe for consumption (DSHS 1997, 1).

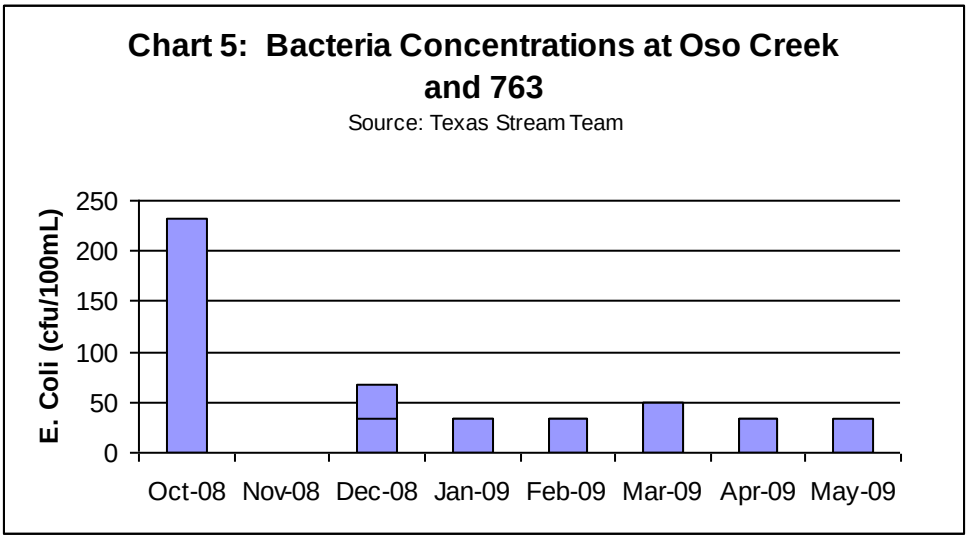
There have been other problems for the Gulf of Mexico in the past. There were "concern for screening" levels in 2006 for chlorophyll-a and phosphorus from Sabine Pass to the Sea Rim State Park area, and near the Jefferson-Chambers County line area (TCEQ 2006c, 128). The Gulf of Mexico was not listed in 2008 (TCEQ 2008d). In 1999, D.O. concentrations near Sabine Pass were occasionally lower than the optimal conditions for aquatic life (TCEQ 1999, 33). These conditions were delisted in 2006 (TCEQ 2006b, 15).

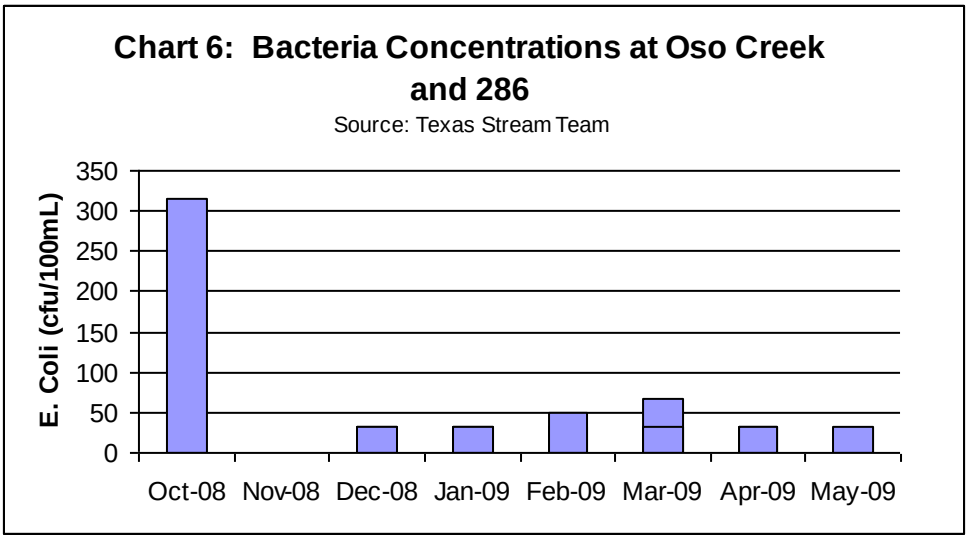
Water Quality in Oso Bay / Creek

Oso Creek is one of two freshwater tributaries to the Nueces and Corpus Christi Bays. It flows directly into Oso Bay and drains an area of approximately 255 square miles. Oso Bay is an enclosed, shallow body of water with a surface area of approximately 7 square miles. It provides a habitat for many plants and animals and plays an influential role in water purification and storm protection. It borders Corpus Christi and Robstown. Economic activities include oil and gas refining and production, agriculture, manufacturing, and tourism (TCEQ 2007, 1).

Oso Bay and Oso Creek are currently considered impaired under state regulations. The TCEQ started a TMDL program for Oso Bay and Oso Creek in September of 2004 due to high concentrations of bacteria (TCEQ 2007, 2). Oso Bay was first listed on the 303(d) list in 1996 for depressed dissolved oxygen levels and in 2006 for high bacteria levels in oyster waters. Oso Creek was first placed on the 303 (d) list in 2002 (TCEQ 2008e, 116). Chlorophyll-a, phosphorus, and ammonia are listed in the 2008 Water Quality Inventory as "concerns for screening" levels in Oso Bay. Nitrates, phosphorus, and chlorophyll-a are the concerns for Oso Creek (TCEQ 2008d, 133).

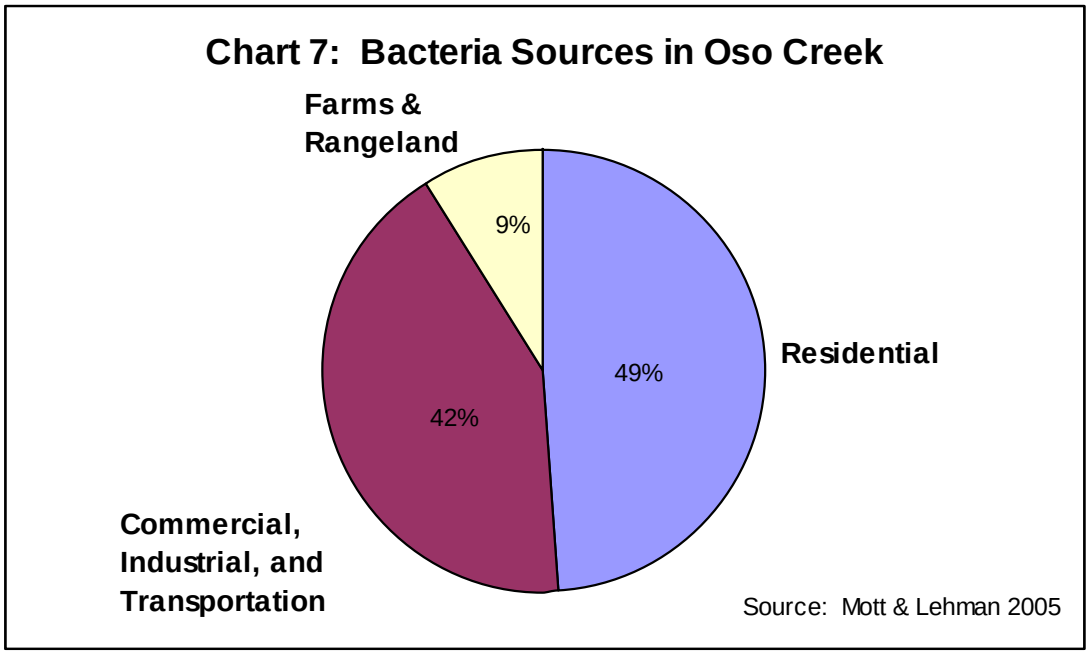
Because Oso Creek has a low natural flow and many permitted municipal discharges, bacteria levels are typically in exceedance of the standard. Because permitted effluent makes up most of the flow in the creek, this condition has become to be expected (Nicolau 2001, i-ii). This has led to a dramatic drop in dissolved oxygen and a rise in pH levels which can present poor conditions for aquatic life (Nicolau 2001, ii). Nutrients stay in the creek for prolonged periods of time due to the naturally low gradient of the streambed, which then wash into Oso Bay during high precipitation events. Biological indicators of poor water quality such as oligochaetes and chironomids completely dominate samples taken from Oso Creek (Nicolau 2001, ii). Volunteer monitor data from the Texas Stream Team database shows levels that meet standards since October 2008 when data collection for this site began (Charts 5 & 6). The state of Texas single sample standard for *E.coli* is 394 cfu/100mL. The low *E.coli* values could be a result of the drought, as diffused pollution over the watershed will not usually flow into a water body without be conveyed by storm water runoff.





The water quality in Oso Bay is considerably better than Oso Creek. This is most likely caused by the significant amount of Upper Laguna Madre water discharged through the CP&L-Barney David plant, which creates a buffering effect as more water can curb adverse influences. Most of the bay except for the area around the City of Corpus Christi's Oso Wastewater Treatment Plant has a high species richness and abundance. Problems in the bay include high salinity with extreme fluctuations, low dissolved oxygen also with extreme diurnal fluctuations, and bacterial contamination of oyster waters. Wide diurnal fluctuations in dissolved oxygen are common in such shallow, highly saline systems with warm water (Nicolau 2001, ii).

There are ten permitted dischargers into the creek including six wastewater treatment plants. All wastewater treatment plants are required to treat water before discharging it back into the water body using chlorine or ultra-violet light. Three of the wastewater treatment plants which discharge more than one million gallons per day must also de-chlorinate the water to avoid adverse impacts of aquatic life (Chief 2007, 8-9). Non-point sources include eleven livestock feed lots, ten storm-water outfalls, and ten rural subdivisions within the watershed (Chief 2007, 11). Figure 1 shows the distribution of livestock, wastewater outfalls, and rural subdivisions within the Oso Creek watershed. A TCEQ analysis found 49% of the bacteria comes from residential sources; 42.3% from industrial, commercial, and transportation; and 8.7% from farm and rangeland (Chart 5) (Chief 2007, 18-19).



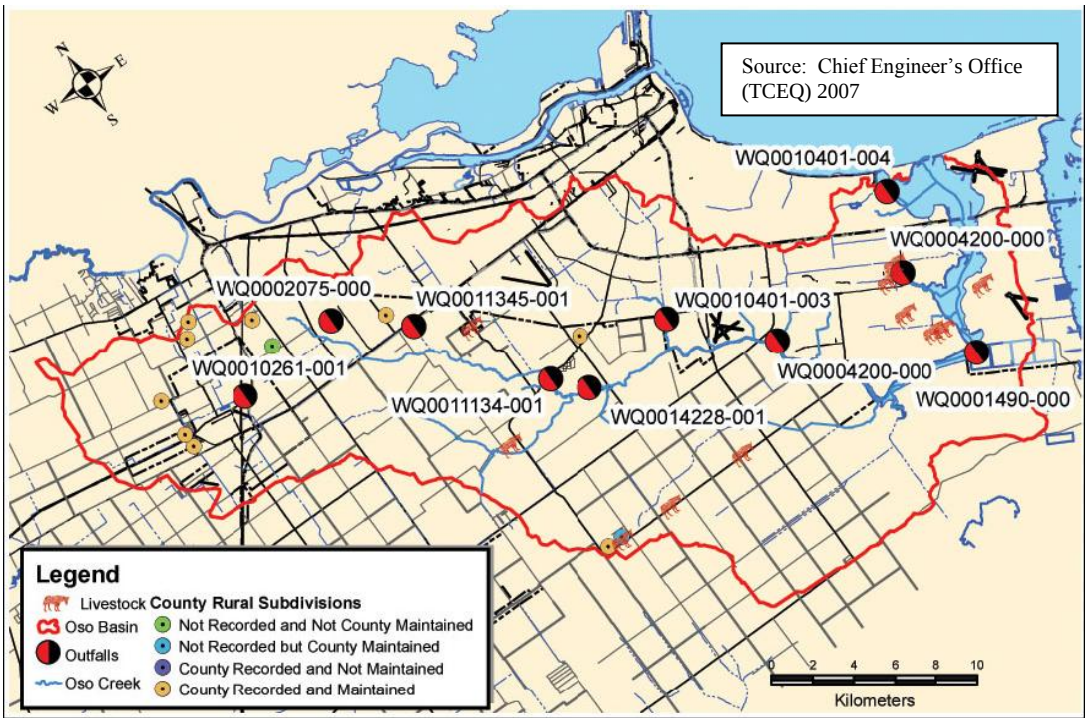


Figure 1: Distribution of livestock, wastewater outfalls, and rural subdivisions within Oso Creek watershed.

If groundwater becomes contaminated with bacteria, it can be a long lasting problem. The most common source of bacteria in residential areas is usually septic tanks. Bacteria are ideally eliminated within the septic tank, but leaks can undermine this process. The majority of soils in the Oso Bay area are clay. Therefore, they are less permeable than every other type of soil. As a result, they do not filter percolating water and the short distance to the groundwater table in this area makes the groundwater especially susceptible (Chief 2007, 20).

In 2008, Texas Stream Team, in conjunction with Texas A&M Corpus Christi, conducted a 3day non-point source pollution education session. As a result, volunteer monitoring activity increased drastically in the Oso Creek watershed. Texas Stream Team met with the Coastal Bend Bays and Estuaries Program, the Coastal Bend Bays Foundation, and the Harte Research Institute for Gulf of Mexico Studies to discuss the focus on bacterial issues. It was agreed that residents of the colonias (impoverished communites along the U.S./Mexico border which lack substantial infrastructure) should be included in the meetings (TST 2009). The Texas State Soil and Water Conservation Board have funded more analyses of bacteria sources which should be completed by September 2010. The Total Maximum Daily Load Program will move forward following these analyses.

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Appendix 1: Bacteria Levels in Mustang Island State Park (2003-2008)

Source: Texas Beach Watch