GALVESTON BAY REPORT CARD

2019

HARC

GALVESTON BAY FOUNDATION

OVERVIEW SECTION
FULL REPORT PDF

OVERVIEW SECTION

Photo by Andrew Hancock

Galveston Bay is a vibrant, resilient ecosystem, but faces an uncertain future. The Bay's watershed is home to the fifth largest city in the U.S., Houston. It is also home to three ports, and remains a hub for the manufacturing and refining of chemicals and petroleum products. However, people, industry, and commerce often come with environmental challenges. Galveston Bay's most significant problems are tied to pollution, declines in habitat acreage, and the impacts of climate change, such as sea level rise.

That Galveston Bay could receive a grade of C for overall health despite facing these monumental issues shows how resilient it is. This offers hope that we can change our negative impact on water quality, wetlands, seagrasses, and wildlife. But a healthier Galveston Bay is in everyone's interest.

About the grade: The combined GPA for all six categories together is 2.5, which registers in the mid-C range. This year, we were able to add a new grade: oyster population, under the Wildlife category. We were also able to provide an estimated wetland grade based on data from H-GAC. Unfortunately, there were not enough data available for Litter and Trash or Oyster Reefs to include them in the overall grade. We hope you will join us in encouraging local, state, and national leaders to pass legislate on, and provide funding for, improved monitoring to address these issues.

OVERALL HEALTH OF THE BAY

About the Bay

Galveston Bay is Texas' largest bay, covering about 600 square miles. The Galveston Bay watershed — the area of land that drains into a given body of water — is about 24,000 square miles. It stretches northward from the Houston metropolitan area, up the Trinity River basin, and past the Dallas-Fort Worth area. Half the population of Texas currently lives in the Galveston Bay watershed. The Bay's urbanized, industrialized, and agricultural setting poses unique challenges for water quality, habitat protection, and resource conservation. If you live, work, or go to school in the Galveston Bay Watershed, you can find your local watershed now.

Galveston Bay is, by definition, an estuary – a semi-enclosed coastal body of water that has a free connection with the open sea. Within an estuary, seawater mixes with freshwater from the land. In the case of Galveston Bay, it is where freshwater from the Trinity and San Jacinto rivers and the extensive bayous and creeks of the Houston-Galveston region mix with the saltwater of the Gulf of Mexico.

Estuaries are among the most productive ecosystems in the world. They are home to a huge amount of plant and animal life, and can produce large harvests of recreational and commercial fish and shellfish.

People are drawn to the water – for good reason. Galveston Bay and the habitats within its watershed provide many benefits to society, including:

- Fisheries/seafood.
- Water quality improvement.
- Erosion, flood, and storm protection.
- Regulation of local climate.
- Aesthetics and recreational opportunities such as swimming, boating, and bird watching.

Ensuring a healthy future for Galveston Bay is ensuring that future generations can enjoy a safe place to not only live, but also swim, boat, and fish.

About the Project

The Galveston Bay Report Card is a citizen-driven, scientific analysis of the health of Galveston Bay. Supported by a grant from Houston Endowment and implemented by the Galveston Bay Foundation and the Houston Advanced Research Center, the report card's goal is to engage community members in meaningful discussion about Bay health topics. The report card is also designed to inspire people to take actions that protect and preserve the Bay. The 2019 report card is the fourth release, and we plan to update the report annually.

Through a series of surveys and interactive presentations, six topic categories were identified by the Galveston Bay Foundation as health topics of interest to the public in the fall of 2014: Water Quality, Pollution Events & Sources, Wildlife, Habitat, Human Health Risks, and Coastal Change. Scientists from HARC (the Houston Advanced Research Center) then analyzed data and trends for 19 indicators. What has emerged is a compelling story about Galveston Bay, its challenges, opportunities, and greatest needs.

Each indicator features easy-to-understand grades, similar to the grades you would find in a school report card. These indicators show specific ways you can help the Bay, as well as data-driven infographics, additional resources, and a downloadable full report with expanded content. There is also specific data on each indicator.

How We Grade

It is not easy to measure how "healthy" a bay system is. Estuaries are extremely dynamic environments that change by the minute. It is not always clear how much stress a particular component of the bay can take before it begins to deteriorate, how fast it may deteriorate, or if recovery after deterioration is even possible. The way an individual defines a "healthy" bay is often related to how we, as humans, value the services that the system provides us, such as seafood harvests, clean water for drinking and playing, and habitat that protects and stabilizes shorelines.

The goal of the federal Clean Water Act of 1972 is to make the nation's waters swimmable and fishable. That goal was our guideline in measuring the indicators for this report card. In this project, the Bay's health is perceived as a question of sustainability and resiliency: Do the indicator trends portray a Bay that will continue to provide recreation, food, clean water, and protection from storms?

Instead of trying to apply a universal grading methodology to such a variety of Bay indicators, some degree of best professional judgment was used to determine overall category grades and indicator grading scales. A detailed explanation outlines how grades were calculated and when grading relied heavily on best professional judgment based on available data. This is disclosed in the downloadable PDFs for each indicator. Letter grades correspond to a 4.0 grade point average scale, and are accompanied by descriptors ranging from "Excellent" to "Critical."

CONTACT US

Working Together For a Healthy Bay

As Texans and residents of the Galveston Bay watershed, we all carry the responsibility of protecting and preserving the Bay for future generations. The Bay is at the heart of immense ecological and economic productivity. It's also a special place to many people who enjoy its views, tranquility, and recreational opportunities. The indicators selected for this report represent a diverse cross-section of Bay features, but they are not intended to be all-encompassing. We have already identified a few topics for future indicator expansion: water clarity, chlorophyll-a concentrations (an indicator of productivity at the base of the food chain), marine mammals and reptiles, land use/ development, harmful algal blooms, and species range expansions.

We welcome your comments, suggestions and ideas to improve the report card, which we plan to update annually. A healthy environment is good for the communities we live, work, and play in. So please share this report with your family and friends. We encourage you to ask questions and seek innovative solutions to challenging environmental issue.

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WATER QUALITY
2019 GALVESTON BAY REPORT CARD

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WATER QUALITY

In each of the report card sections, you can learn a little more about how various indicators impact the Bay and the many species within it.

SUMMARY

- The overall water quality of Galveston Bay is good.
- Water quality in the Report Card is assessed using information describing nutrient and dissolved oxygen levels.
- Nutrient pollution can cause algae blooms, deplete oxygen, and even kill marine life.

B

OVERALL WATER QUALITY GRADE

The Galveston Bay watershed received a B for water quality samples collected in 2018. This year's good grade is consistent with long-term trends of generally improving water quality as a result of Clean Water Act implementation and ongoing implementation of Watershed Protection Plans in our region (locally-driven, watershed-specific plans to voluntarily address complex water quality problems in the region). 2018 was not as rainy as previous years, which may explain the increase in phosphorus levels in some watersheds back to 2014 levels. As the Galveston Bay watershed's human population grows, more land is developed for homes, businesses, and transportation infrastructure. In response to changes in land use, new strategies will be needed to keep the Bay from being overloaded with nutrients that degrade water quality.

A good way to gauge the health of Galveston Bay is to assess the levels of life-sustaining nutrients and oxygen. Energy from the sun and elements like nitrogen and phosphorus are necessary for plants such as microscopic algae, seagrasses, and wetland grasses to exist in the Bay. These form the base of the food web upon which the entire ecosystem depends.

The water in Galveston Bay flows from watersheds on land into rivers and bayous, picking up nutrients and contaminants along the way. Too many nutrients can have negative effects on the health of the Bay. Surface waters in some watersheds contain more nutrients than they should. We need to watch those areas and determine the causes of elevated nutrient levels to ensure those nutrients do not cause more widespread problems in the future.

What is Nutrient Pollution?

Too many nutrients from human activities, like over-fertilizing and discharging wastewater, can alter the natural balance of nitrogen and phosphorus in our waterways. When nutrient levels are too high, they can lead to algae blooms, oxygen depletion, and hypoxic (low oxygen) or anoxic (no oxygen) zones that can kill fish and bottom-dwelling animals.

Photo by Anna Armitage

Making the Grade

The levels of nutrients and dissolved oxygen found in samples taken from rivers, bayous, and the Bay itself in 2018 were most often at acceptable levels for supporting diverse and healthy aquatic life. So overall water quality earned a B grade. The water quality problems that did exist — relating to high levels of phosphorus — typically occur in bayous that receive runoff and wastewater from human activity in residential, industrial, commercial, and agricultural areas.

A	B	C	D	F	I
EXCELLENT	GOOD	ADEQUATE FOR NOW	REQUIRES ACTION	CRITICAL	INSUFFICIENT DATA

WHAT YOU CAN DO

SLOW YOUR RUNOFF: Nutrient pollution often peaks after heavy rainfall because of the particles picked up by the rain as it flows down roadways into storm drains, and then into the Bay and its tributaries.

There are several ways to slow runoff:

- Reduce or replace concrete areas with porous coverings like gravel and Install rain barrels to collect rainwater from your roof.
- Keep as much green space as possible on your property.

Learn more: www.galvbay.org/rainbarrel

PICK UP AFTER YOUR PETS: Properly dispose of pet waste in the trash. Pet waste contains excess nitrogen and phosphorus. Those nutrients get carried from yards and parks by storm and irrigation runoff into creeks and other tributaries that flow into Galveston Bay.

Learn more: www.petwastepollutes.org

CONSERVE:

- Electricity generation and transportation that require fossil fuels add nitrogen to the air, which is then deposited into our waterways from rain and runoff.
- Fertilizers contain nitrogen and phosphorus, and overwatering creates standing water and runoff.
- Some detergents (such as laundry, dish, and car-washing soaps) contain phosphorus.

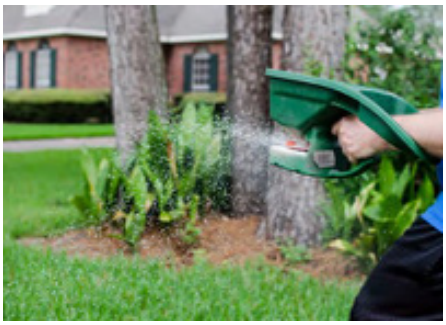


Photo by Anja Borski

Photo by Chris Kuhlman CK Productions

BE A CLEAN WATER PARTNER: Community groups and organizations — including schools, business and cities — can offer educational programs and service projects to their constituents by contacting the Galveston Bay Foundation's Water Programs.

JOIN IN: Participate in watershed protection planning initiatives in your area. For programs on the east side of the Bay, visit the Houston-Galveston Area Council website, and for the west side (Liberty County), visit the Double Bayou Watershed Partnership website.

NITROGEN

- Nitrogen stimulates plant growth.
- Too much nitrogen can cause the overgrowth of algae (or an “algae bloom”), which can deplete oxygen in the water.

Algae blooms can choke waterways and lead to low oxygen levels in the water. Some algae can even be toxic to humans, posing a threat to recreation and clean water for drinking.

Rivers and Bayous Nitrogen Grade: A (Excellent)

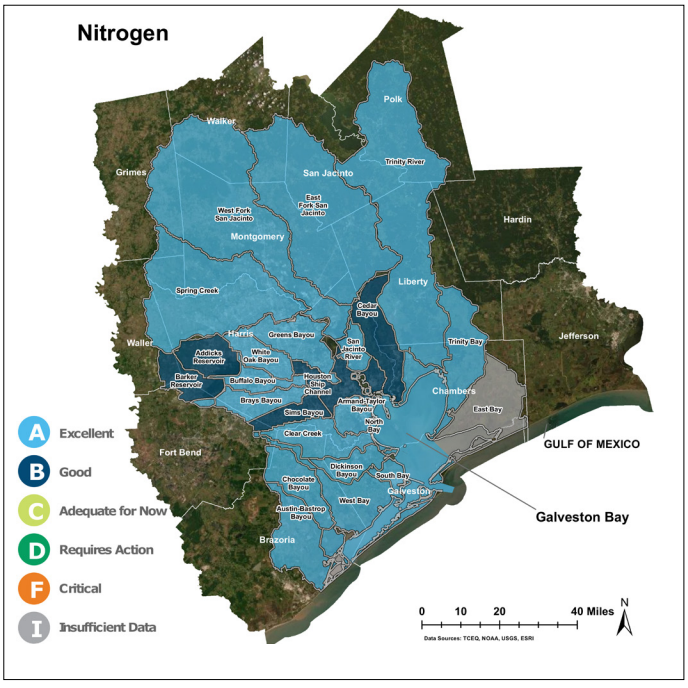
Only 12 percent of samples collected from the rivers and bayous surrounding Galveston Bay were above nitrogen screening levels in 2018, down from 14 percent in 2017. In these waterways, a significant percentage of flowing water can come from wastewater treatment plants, particularly in dry, summer months. How that wastewater is treated — as well as what the runoff carries (fertilizer, pet waste, and other pollution from roads, parking lots, and yards) — impacts how much nitrogen is in the water of a river or bayou. If nitrogen levels in rivers and bayous become too high, Galveston Bay will likely be affected downstream.

The majority of watersheds in the Galveston Bay region receive an A grade. However, some of the region’s most urbanized watersheds (Addicks Reservoir, Barker Reservoir and Sims Bayou) receive B grades. It is notable that 2018 was a dryer year than 2017, which can impact the volume of runoff flowing through our region’s bayous into the Bay.

Galveston Bay Nitrogen Grade: A (Excellent)

The 2018 nitrogen concentrations in Galveston Bay exceeded screening levels in only 1 percent of samples collected, down from 17 percent in 2017, earning the Bay an A.

Water quality concentrations (such as how much nitrogen is in the Bay and its tributaries) are monitored by federal, state, and local agencies. Data describing nitrogen concentrations in rivers, bayous, and the waters of Galveston Bay were obtained from the Texas Commission on Environmental Quality (TCEQ) Surface Water Quality Monitoring Program and the TCEQ/H-GAC Clean Rivers Program.



NITROGEN

Nitrogen grades are based on total ammonia-nitrogen in water. Ammonia was chosen to represent this indicator because the TCEQ data on it were the most complete for both tidal and non-tidal waters. Grades reflect the percent of samples that exceeded TCEQ screening levels in 2018, meaning the samples were above the range that is acceptable in Texas. The grading scale is based on the best professional judgement of coastal and estuarine scientists. This scale is also used to set water quality parameters in other coastal report cards, such as the one for Chesapeake Bay.

Grade	Percent of Samples Exceeding Screening Level
A	0-20%
B	21-40%
C	41-60%
D	61-80%
F	81-100%
I	(Insufficient Data)

WHAT YOU CAN DO

Keep Excess Nitrogen Out of Our Waterways

- Follow fertilizer directions carefully and don't over-fertilize or over-water your lawns or gardens.
- Have septic systems inspected and repaired if they are not functioning properly. The Houston-Galveston Area Council (H-GAC) estimates that there are more than 300,000 onsite sewage facilities in its 13-county service area. Learn more and see a map of septic systems in your area.
- Leave as much of your property unpaved as possible so rainwater has a chance to soak in rather than run off.
- Plant a rain garden to prevent rainwater from running into storm sewers. Choose native plants that grow well in our climate and use compost instead of fertilizer.

Nitrogen enters the Galveston Bay system through wastewater, fertilizer from yards and agricultural lands, and runoff from paved surfaces. Besides being an important component of unhealthy ground level ozone (smog), airborne nitrogen from vehicle exhaust, electricity generation, and some industrial processes can be deposited into waters of the Bay and its rivers and bayous.

Photo by Anja Borski

PHOSPHORUS

- Like nitrogen, phosphorus stimulates plant growth, but too much contributes to algae blooms.
- Phosphorus — commonly found in fertilizers, detergents, manure, sewage, and industrial wastewater (effluent) — attaches to soil particles. This makes erosion a factor in phosphorus pollution.

Just like having too much nitrogen, too much phosphorus can cause an overgrowth of algae (or an "algae bloom"). Algae blooms can choke waterways and lead to low oxygen levels in the water. Some algae can even be toxic to humans, posing a threat to recreation and clean water for drinking.

Rivers and Bayous Phosphorus Grade: C (Adequate for Now)

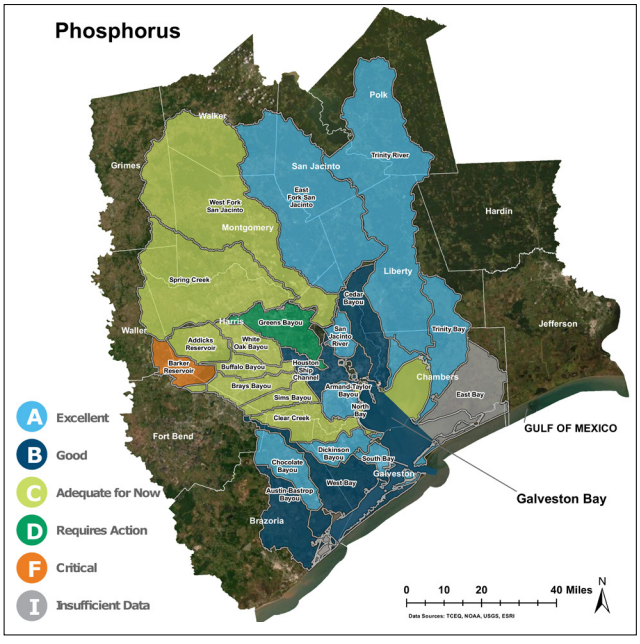
In 2018, ten sub-watersheds of Galveston Bay scored C or D for exceeding the phosphorus water quality standards with one watershed, Barker Reservoir, scoring an F. About 41 percent of all samples exceeded total phosphorus screening levels, resulting in a grade of C.

Many southern and eastern watersheds in the Galveston Bay region receive the grade of A or B. However, the region's most urbanized watersheds extending from Clear Creek northward to Spring Creek in Montgomery County continue to receive B, C and D grades. These watersheds reflect some of the most heavily populated, urban land uses in the region yielding larger volumes of rainfall runoff flowing from yards, parking lots and streets.

Galveston Bay Phosphorus Grade: B (Good)

In 2018, 28 percent of samples collected in Galveston Bay waters had phosphorus levels above screening levels set for the protection of water quality, up from 11 percent in 2017, which qualifies as a B.

Water quality concentrations such as phosphorus are monitored by federal, state, and local agencies. Data describing phosphorus concentrations in rivers, bayous, and the waters of Galveston Bay were obtained from the Texas Commission on Environmental Quality (TCEQ)
Surface Water Quality Monitoring Program and the TCEQ/H-GAC Clean Rivers Program.



PHOSPHORUS

Phosphorus grades are based on the amount of phosphorus in the water. Grades reflect the percent of samples exceeding TCEQ screening levels in 2018, meaning those levels were above the range that is acceptable in Texas. The grading scale is based on the best professional judgement of coastal and estuarine scientists. This scale is also used to set water quality parameters in other coastal report cards, such as the one for Chesapeake Bay.

Grade	Percent of Samples Exceeding Screening Level
A	0-20%
B	21-40%
C	41-60%
D	61-80%
F	81-100%
I	(Insufficient Data)

WHAT YOU CAN DO

Keep Excess Phosphorus Out of Our Waterways

- Use phosphate-free or phosphate-reduced laundry, dish, and car-washing soaps.
- Incorporate landscaping techniques that require less fertilizer, like growing a garden with native plants.
- Control erosion. Phosphorus attaches to soil particles, making erosion a contributor to phosphorus pollution.

Phosphorus concentrations in Galveston Bay waters have declined greatly since the early 1970s thanks to the success of the Clean Water Act and the switch to phosphate- free or phosphate-reduced formulas for laundry, dish, and car-washing soaps. However, some detergents are still high in phosphates, and Texas has not yet joined the list of states with legislation banning their use.

Most phosphorus pollution today comes from runoff from the land. There are several ways to reduce this kind of runoff. They include relying on landscaping techniques that require less fertilizer, taking steps to prevent erosion, and using native plants.

Learn more

Photo by Anja Borski/Galveston Bay Foundation

DISSOLVED OXYGEN

- Adequate oxygen levels are required to support aquatic life in Galveston Bay.
- Hypoxia (low-oxygen) and anoxia (no-oxygen) zones are common in water that is warm, still, and has poor clarity. These areas are commonly seen following large algae blooms.
- Benthic (bottom-dwelling) organisms, like oysters, cannot escape hypoxic conditions. Most animals will die if caught in anoxic water for any length of time.

Rivers and Bayous Dissolved Oxygen Grade: A (Excellent)

Like nutrients, oxygen is a natural and vital component for supporting life in our Bay and tributaries. Oxygen is introduced when surface water mixes with air, and when aquatic plants produce oxygen during photosynthesis. Dissolved oxygen tends to be lower in warm waters and in waters with poor clarity that block the light needed for photosynthesis. The growth, die-off, and decomposition of aquatic plants can also lead to low levels of dissolved oxygen. This is why we often see sudden reductions in dissolved oxygen levels following large algae blooms.

Hypoxia is the term used to describe low levels of oxygen in the water. The absence of dissolved oxygen is called anoxia, and most animals die if caught in anoxic water for any length of time. Some animals, like fish, can escape hypoxic or anoxic conditions. But organisms that are attached to surfaces like a rocky bay bottom or piers and docks cannot move freely. They will die if they cannot get enough oxygen from the water around them. Fish and shellfish species can usually recover from temporary and sporadic periods of low oxygen, which are not uncommon during hot, dry weather. But prolonged or chronic periods of reduced oxygen in water can affect the longer-term status of fish and shellfish populations.

Shaded bayou and stream banks offer protection from direct sunlight, which can rapidly increase water temperatures and lower dissolved oxygen levels. It is vital that we all work to preserve and restore the forests and wetlands that protect the shores of Galveston Bay's rivers and bayous. Because of their shallow and often slow-moving nature, the rivers and bayous are at a higher risk of low dissolved oxygen during hot, dry weather or algae blooms.

Photo by Irene Amiet

DISSOLVED OXYGEN

Rivers and Bayous Dissolved Oxygen Grade: A (Excellent)

Dissolved oxygen levels were below screening levels in 11 percent of samples collected from rivers and bayous surrounding Galveston Bay in 2018. Three watersheds received grades of B: Dickinson Bayou, Sims Bayou and Trinity Bay watershed.

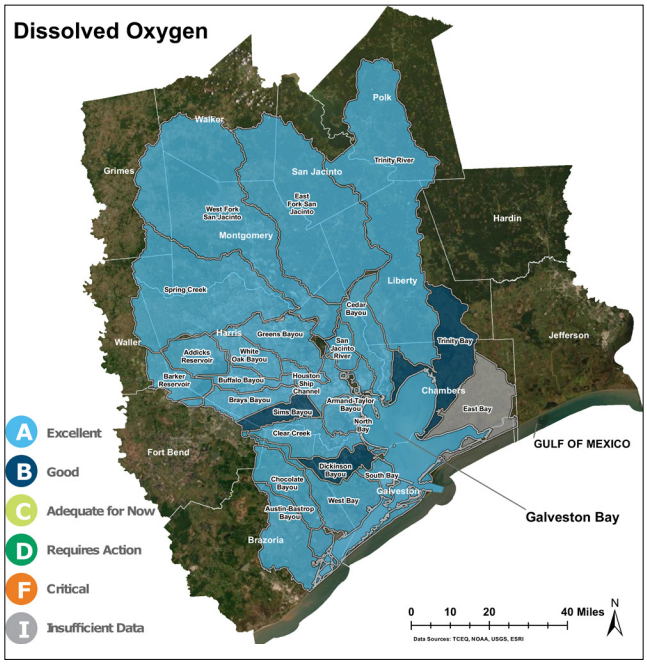
Galveston Bay Dissolved Oxygen Grade: A (Excellent)

In 2018, only two percent of samples collected in Galveston Bay waters had dissolved oxygen levels below the screening levels set for the protection of aquatic life.

About the Data

Data describing dissolved oxygen concentrations in rivers, bayous, and the waters of Galveston Bay were obtained from the Texas Commission on Environmental Quality (TCEQ) Surface Water Quality Monitoring Program, the TCEQ/H-GAC Clean Rivers Program, and partner agencies. The TCEQ data were combined with dissolved oxygen data collected by the Texas Parks and Wildlife Department (TPWD) Coastal Fisheries Division.

Dissolved oxygen grades are based on dissolved oxygen in water, and the percent of samples falling short of TCEQ screening levels in 2018 (meaning they were below the range that is acceptable in Texas).



DISSOLVED OXYGEN

The grading scale for water quality indicators (nitrogen, phosphorus, dissolved oxygen) shows the status of those indicators in 2018 around the Galveston Bay system. This scale is based on the best professional judgment of coastal and estuarine scientists. This scale is also used to set water quality in other coastal report cards, such as the one for Chesapeake Bay.

Grade	Percent of Samples Exceeding Screening Level
A	0-20%
B	21-40%
C	41-60%
D	61-80%
F	81-100%
I	(Insufficient Data)

WHAT YOU CAN DO

Our Actions Impact Dissolved Oxygen Levels

- Help preserve and restore habitats that help promote high oxygen levels, like forests and wetlands.
- Help prevent nutrient pollution by following the steps to reduce nitrogen and phosphorus levels in Galveston Bay.
- Find out what else you can do about nutrient pollution.

Preserving and restoring forests and wetlands that protect the shores of Galveston Bay and its rivers and bayous can improve dissolved oxygen levels in the water. Plants help to remove nutrients, and trees provide shade to lower water temperatures. This helps to maintain oxygen levels.

Every summer, a hypoxic zone forms in the northern Gulf of Mexico off the coasts of Texas and Louisiana. In this massive region, the water near the bottom of the gulf contains less than two parts per million of dissolved oxygen. Because few organisms can survive under hypoxic conditions, this area is also known as the “Dead Zone.” The Dead Zone is caused by excessive nutrients from human activities (fertilizers, wastewater, erosion, etc.). Also, floods, droughts, and hurricanes influence its size. The large size and location of the Gulf of Mexico Dead Zone cause major ecological and economic problems in the entire Gulf of Mexico ecosystem, including Galveston Bay.

In order to improve or maintain dissolved oxygen levels in the Galveston Bay watershed, we all need to take a look at ways we can reduce excess nutrient runoff.

POLLUTION EVENTS & SOURCES

2019 GALVESTON BAY REPORT CARD

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POLLUTION EVENTS & SOURCES

Photo by Chris Kuhlman

SUMMARY

- There were no major spills in 2018, and the number of spills was lower compared to previous years.
- Trash in rivers, bayous and the Bay is inadequately monitored; we do not know enough about types of waterway trash, sources of litter or amounts in water.
- A long history of industrial contamination has polluted Galveston Bay sediment in some areas. Some contaminants are known to persist in the environment for many years, even after they are no longer produced. These are monitored in parts of Galveston Bay and the Houston Ship Channel.

B

OVERALL POLLUTION EVENTS & SOURCES

Galveston Bay received a B for pollution events and pollution sources for the most recent data available in 2019.

Galveston Bay's long history of industrial manufacturing has caused environmental damage. The pollution from this manufacturing has left toxic compounds in the sediment of our rivers, bayous, and Galveston Bay itself. Sediments are monitored in Galveston Bay and the Houston Ship Channel, but are only monitored in a few rivers and bayous.

Litter and trash can also threaten the environment and human health. However, there is little data regarding the types of waterway trash, sources of litter or amounts in the Bay and bayou waters. This lack of information results in a grade of "incomplete" for litter and trash.

Living with the Damage

Oil spills and toxic contamination are environmental risks we live with as Galveston Bay's local economy benefits from shipping and industrial activity. The good news is that the Bay is a less toxic place now than in the years before the Clean Water Act of 1972. As we learn more about the harmful compounds that result from manufacturing products and chemicals, we have strengthened regulations and found innovative ways to reduce pollution from industrial runoff and wastewater. Industries along the Bay have invested in technologies to reduce pollutants and improve safety, and those investments are paying off.

However, some toxics, like PCBs, have been banned for decades but are still present in the environment. There are also more people living and contributing to pollution and trash in the Houston area now than there were in the 1970s, and the population is expected to keep growing. There is still plenty of work to be done to clean up Galveston Bay.

WHAT YOU CAN DO

Back the Bay by Keeping It Clean

REPORT

- Environmental emergencies, discharges, spills or air releases can be reported to the Texas General Land Office and the Texas Commission on Environmental Quality at 1-800-832-8224.
- The Galveston Bay Action Network is an interactive tool for submitting and viewing water-related pollution and waste dumping reports across the four counties that touch Galveston Bay (Brazoria, Chambers, Galveston, and Harris). Reports are sent directly to the appropriate authorities, so you do not have to do research to find out where to send your concerns.

SPEAK UP

- Contact local officials and legislators about making the cleanup and preservation of Galveston Bay a priority.
- Participate in public processes to clean up known pollution sites, like the San Jacinto River Waste Pits.

PICK IT UP

- Remember that pollution and litter are everyone's problem. If you see trash, pick it up before it ends up in the Bay.

MAINTAIN YOUR VEHICLE

- According to the U.S. Environmental Protection Agency, motor oil from a single oil change can pollute up to a million gallons of drinking water.

REPORT

- Toxic chemicals pose a threat to the environment and our health.
- Contaminants often attach to particles of soil, rather than water.
- Toxins are known to biomagnify, or build up, in the food chain, contaminating our seafood.
- Participate in public processes to clean up known pollution sites, like the San Jacinto River Waste Pits.

Toxic chemicals pose a threat to our environment and health. Many of these toxic contaminants are found in higher concentrations in sediment — the materials (like soil and rocks) that are washed down rivers and bayous. Sediment eventually settles to the bottom of a body of water. Toxic contaminants within sediment can attach to particles of soil and then find their way into the food chain.

The report card looks at five of these contaminants: PCBs, dioxins, PAHs, pesticides, and metals.

ORGANICS:

- PCBs, or polychlorinated biphenyls, can be found in electrical transformers and other equipment. While the manufacture of PCBs has been banned since 1979, they may be present in products and materials produced before the ban. PCBs are considered a legacy pollutant, a class of toxics that persist in the environment from contamination that largely occurred in the past.
- Dioxins are chlorinated byproducts of chemical manufacturing, incineration, and the pulp and paper industry. The EPA Superfund site known as the San Jacinto River Waste Pits is a former paper mill waste disposal site that is a significant source of dioxin contamination in Galveston Bay, and it's most likely not the only one. Dioxin may also enter the Bay through the air. Dioxin is monitored at the San Jacinto River Waste Pits, but not elsewhere in Galveston Bay.
- PAHs, or polycyclic aromatic hydrocarbons, are a class of chemicals most often deposited into the Bay through the air. PAHs result from the incomplete burning of coal, oil, gas, garbage, or other organic substances. They may also get deposited into the Bay as urban runoff that washes away vehicle pollution.
- Pesticides are substances intended to control insects. Herbicides are used to control weeds and other unwanted plants. Pesticides and herbicides are both used on farmland and residential and commercial properties. When it rains, runoff from yards, farmland, and roadsides carry these chemicals into local streams, bayous, rivers and the Bay itself.

METALS:

- Heavy metals — such as mercury, lead, and chromium — reach the Bay from sources linked to the land, water, and air. For example, mercury and lead can enter the air through manufacturing processes and the burning of coal or waste. Metals are also used in a variety of industrial processes, and found in sources such as paint and batteries.

TOXICS IN SEDIMENT

Galveston Bay Sediment Toxic Content Grade: C (Adequate for Now)

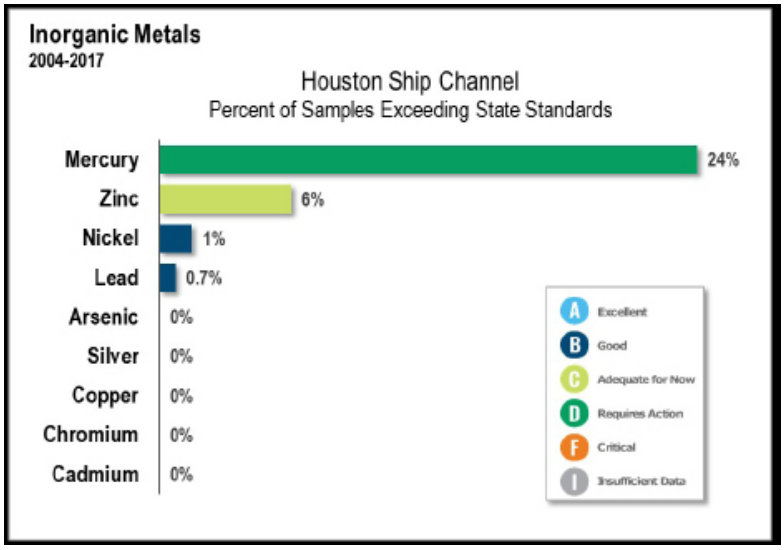
Toxic chemicals pose a threat to our health and the health of the Bay, and have even led to the establishment of Seafood Consumption Advisories. Monitoring programs gather data describing toxins in sediments of Galveston Bay and the Houston Ship Channel, where elevated concentrations of metals such as mercury, and organic compounds such as PCBs, and polycyclic aromatic hydrocarbons (PAHs) are found in sediment.

The grades for Toxins in Sediment are:

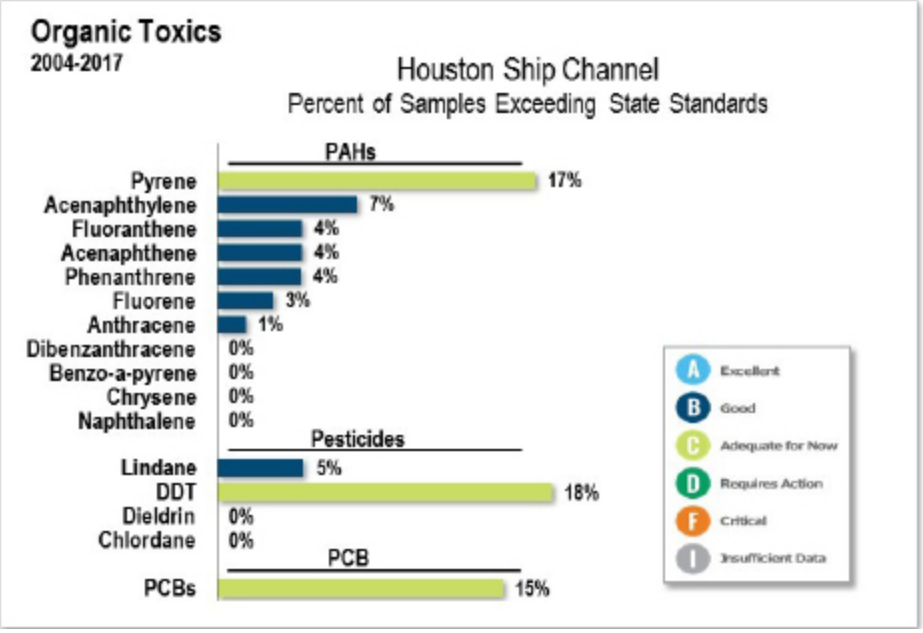
- Toxic metals in sediments of Galveston Bay (A)
- Toxic metals in sediments of the Houston Ship Channel (B)
- Organic toxins in sediments of Galveston Bay (I)
- Organic toxins in sediments of the Houston Ship Channel (B)
- Dioxins in sediments of Galveston Bay (I)
- Dioxins in sediments of the Houston Ship Channel (D)

Dioxins in the Houston Ship Channel, are monitored as part of the San Jacinto Waste Pit superfund site, but there are not enough data to asses a grade for dioxins in Galveston Bay. Therefore Dioxins in Galveston Bay received a grade of “Incomplete”. The danger of legacy pollutants such as PCBs and dioxins is they can persist in the sediment for decades and can move into the Bay food web.

See the Data



TOXICS IN SEDIMENT



About the Data:

Concentrations of toxic metals and organic compounds in sediment are monitored by the TCEQ. The highest concentrations of toxics were found in the Houston Ship Channel, depicted in this chart and data table. Sediment samples are collected and analyzed for toxics only a few times a year. In order to have enough samples to average for a grade, 15 years of data for organics (2004-2017) and 15 years of data for metals (2004-2017) were grouped together. Grades for toxics in the Houston Ship Channel, based on the limited available data, were assigned based on how many sediment samples exceeded the screening level in the last 15 years. There were not enough data for organic toxins in Galveston Bay for a grade, but the Houston Ship Channel grade maintained a grade of B for the second year in a row. Dioxin samples did not have the same thresholds set, so were evaluated according to the best professional judgement of scientists familiar with the San Jacinto Waste Pit contamination.

TOXICS IN SEDIMENT

Grading Scale

The grading scale for toxics was developed as part of the Galveston Bay Indicators Project, by HARC in 2005 based on the best professional judgment of a group of scientific experts. It is more conservative than the quintile scale for water quality indicators because of the relative danger of toxics compared to other substances and the persistence of toxics in the environment.

Grade	Percent of Samples Exceeding Screening Level
A	0-20%
B	21-40%
C	41-60%
D	61-80%
F	81-100%
I	(Insufficient Data)

WHAT YOU CAN DO

Don't Leave a Toxic Legacy

- Always dispose of household hazardous wastes properly.
- Ask your local waste disposal provider about hazardous waste recycling events.
- Help protect the seafood supply for future generations by cleaning up and helping to prevent toxic pollution today.

The presence of dangerous toxic chemicals in fish and shellfish have led to the establishment of Seafood Consumption Advisories. These advisories warn against the consumption of seafood from certain portions of the Galveston Bay system. Cleaning up and preventing toxic pollution today will protect our seafood supply for future generations.
Read more about Seafood Consumption Advisories here.

Additionally, always dispose of household hazardous wastes properly. Ask your local waste disposal provider about hazardous waste recycling events, and learn more about what you can do to minimize environmental impacts from your household wastes.

Learn more.

Photo by Katie Gillis

OIL SPILLS

- Oil spills pollute the air, land, and water
- Oil spills pose a significant threat to vital Bay animals and their habitat.

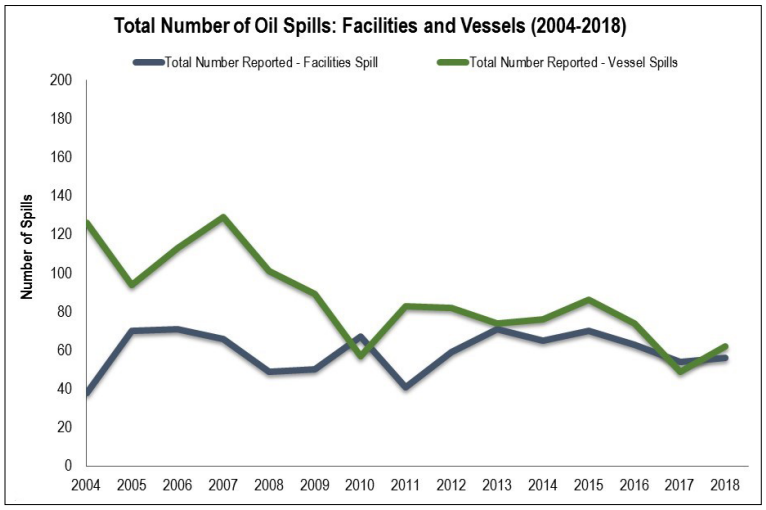
When spilled in water, the lightest components of oil evaporate and become air pollution. Heavier components may float and combine into balls of tar that wash up in shoreline habitats. Meanwhile, the heaviest components sink to the bottom, where they can damage benthic animals like oysters — the organisms that live on or in the Bay sediment.

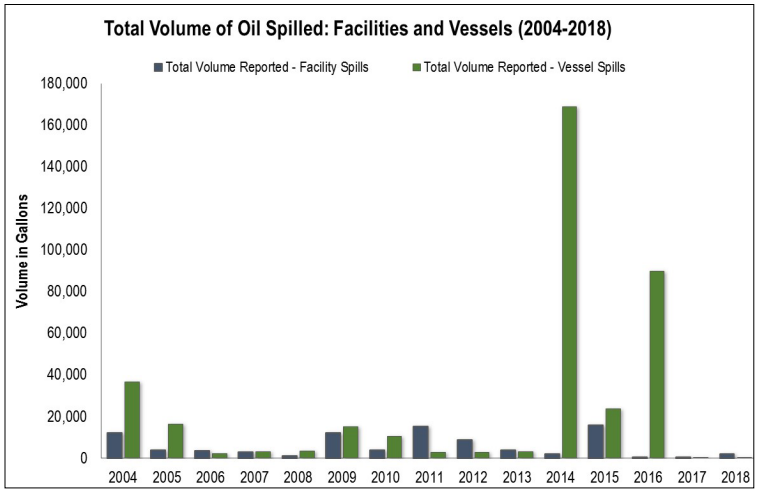
Galveston Bay Oil Spill Grades: Number of Spills – B (Good) Volume Spilled – A (Excellent)

Texas' Oil Spill Prevention and Response program is world-renowned for its proactive and preventive initiatives to keep oil out of our water. However, on average, 226 oil spills have still been reported every year in Galveston Bay since 2004. Most spills are small—less than five gallons—while some are large, such as a September 2016 shipping vessel incident that released 88,000 gallons of diesel fuel into the Houston Ship Channel. The total number of spills has remained below average and earned a grade of B. In 2018, there were no large oil spills, leading to a grade of A for volume spilled.

OIL SPILLS

See the Data





OIL SPILLS

Grading Scale

The Texas General Land Office (GLO) Oil Spill Prevention and Response Program has gathered data describing oil spills in the segment of the Galveston Bay system since 1998. Oil spills are self-reported to the GLO and are listed as facility spills, vessel spills, or unknown/other. The report card compares the number and volume of total spills, facility spills, and vessel spills in 2018 to the average number of spills between 2004 and 2017.

Grade	Percent of Samples Exceeding Screening Level
A	0-49%
B	50-89%
C	90-110%
D	111-150%
F	>151%
IF	(Insufficient Data)

WHAT YOU CAN DO

Keep Oil Out

- If you see oil, report it to the Texas General Land Office (GLO) Oil Spill Planning and Response Toolkit: 1-800-832-8224.
- Avoid eating fish, shrimp, or crabs that either have a chemical smell or taste, or come from areas where oil is present.
- Learn about the assessment and restoration process following the Deepwater Horizon oil spill in the Gulf of Mexico.

Texas' Oil Spill Prevention and Response program is world-renowned for its proactive and preventive initiatives to keep oil out of our water. When oil does spill into the water, the Texas General Land Office (GLO) and U.S. Coast Guard work with the responsible party to stop, contain, and clean up the spill.

Oil from a spill can significantly impact wildlife in the water — on the surface and on shore. Of particular concern in Galveston Bay are the impact of oil spills on already stressed habitats, including oyster reefs. Oysters are an important commercial fishery, and oyster reefs are a key coastal habitat. Learn more in the Wildlife Indicator.

It is always a good idea to avoid eating fish, shrimp, or crabs that have a chemical smell or taste, or are from areas where oil is present. Lasting impacts of Deepwater Horizon oil spill in the Gulf of Mexico are still being studied. There are currently no restrictions on recreational activities due to this incident. Learn more about the assessment, remediation, and restoration process following the Deepwater Horizon oil spill.

LITTER AND TRASH

- Trash can impact water quality by blocking light and natural flow, reducing oxygen levels, and leaching chemicals into the environment.
- Plastics are particularly harmful to animals that ingest them. Consuming plastics can lead to malnutrition, toxic exposure, and often death.

Litter and trash, particularly plastics, are an abundant pollutant in our Bay. Trash is an unsightly problem that plagues communities around the world, and has created islands of swirling plastics in our oceans. Besides physically clogging waterways — which can reduce dissolved oxygen, light, and flow — litter also pollutes waters and sediment when chemicals from the discarded materials leach out or begin to break down. Plastics pose a particular threat to a variety of aquatic life because they persist in the environment for a long time. Aquatic plants and animals have also been known to absorb toxics like PCBs and pesticides, killing the animals outright or incorporating deadly chemicals into the Bay's food chains.

Galveston Bay Litter and Trash Grade: I (Incomplete)

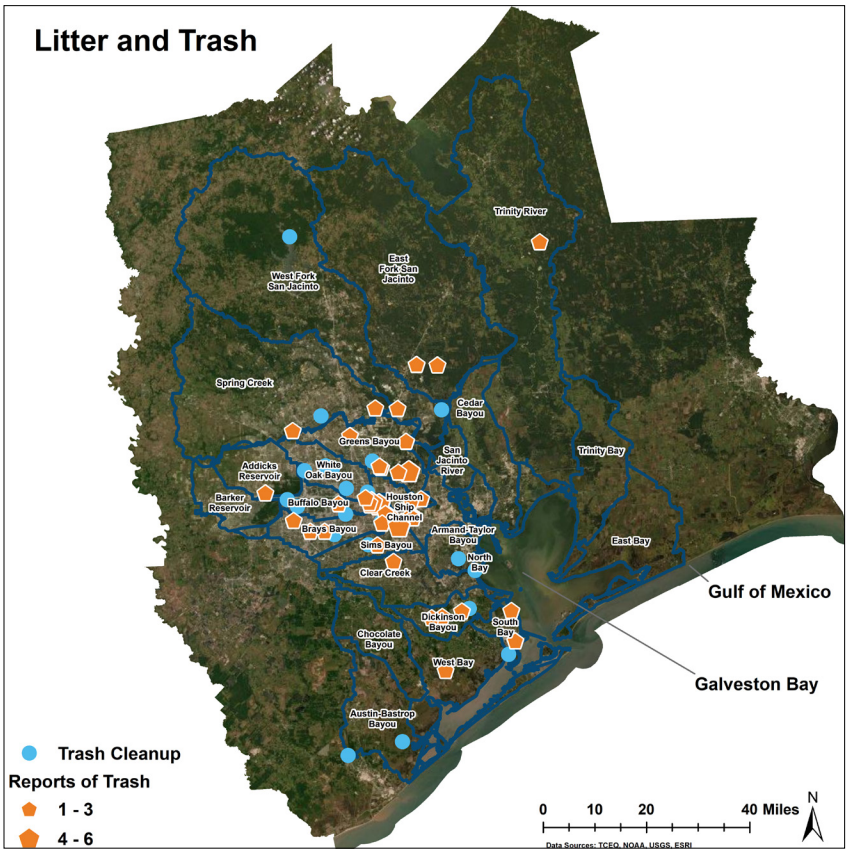
Although litter and trash are widely identified as serious problems for Galveston Bay and its tributaries, there is no Bay-wide or tributary-based monitoring of this kind of pollution. The lack of available data to measure and analyze the impact of litter and trash earns this indicator an I for "Incomplete."

A 2017 report by Texans for Clean Water estimates that while Houston spends approximately $21 million annually on trash prevention, outreach, abatement and enforcement, only $2.5 million is spent every year on prevention. Much work to date has focused on local cleanup efforts, but little has been done to characterize and understand the waterway trash problem in the fifth largest metropolitan area in the United States. Without actionable data describing the waterway trash problem, bayou cleanup and litter prevention efforts led by local organizations will not be able to address the underlying causes.

Data and information are needed to inform and support community-based trash prevention education and clean-up programs.

LITTER AND TRASH

See the Data



Making Connections

Nonprofit organizations around the Houston-Galveston region taken it upon themselves to clean up our waterways. In 2018, Buffalo Bayou Partnership's skimmer boat, litter booms, and other cleanup initiatives have removed over 2,000 cubic yards of trash and debris from Buffalo Bayou, its tributaries, and the Port of Houston. Clean-ups like these are the only large-scale efforts to combat trash in Galveston Bay, in spite of the reports of trash in the rivers and bayous around Galveston Bay.

LITTER AND TRASH

Litter is as much about attitude as it is about action. Whether blown by the wind or carried away by rainwater, most litter eventually finds its way to a body of water like Galveston Bay. Set an example for those around you by practicing tidy habits, like securing your trash and picking up litter when you see it — even if it is not yours.

The EPA estimates that about 13 percent of municipal waste is made of plastic.* Plastic poses a particular threat to wildlife that may ingest it, causing malnutrition, starvation, injury, or illness due to toxicity. Join or start a movement to ban single- use plastic bags, like the Galveston Chapter of the Surfrider Foundation, or volunteer to collect monofilament fishing line for recycling. Organize a cleanup for your neighborhood, local park, stream, or shoreline — or participate in an event like Trash Bash.

*Source: http://www.epa.gov/osw/conserve/materials/ plastics.htm

WILDLIFE

2019 GALVESTON BAY REPORT CARD

Wildlife

Photo by Andrew Hancock

SUMMARY

- The Bay is home to a variety of animals.
- The Bay's wildlife species are valued aesthetically, economically, and for their inherent role in the ecosystem
- Overall, finfish and bird populations are considered adequate and maintaining, while some shellfish populations are deteriorating and require action.

C

OVERALL WILDLIFE GRADE

Galveston Bay and its watersheds are home to a diverse assemblage of wildlife species. Some species are economically important to the region. Examples include species of shellfish — like shrimp, crabs, and oysters — that are harvested and sold to consumers in restaurants and grocery stores. Other species of animals, like speckled trout and flounder, are popular for recreational fishermen. Still other species are important components of the Bay food web (the network of organisms that consume and interact with one another).

Trends in wildlife populations are great indicators of the health of the Bay. Conservation and restoration efforts can be evaluated by looking at increases or decreases in the number of animals found in and around the Bay.

Making the Grade

Many shellfish species appear to be declining and require protection. While white and brown shrimp and oyster populations are holding steady, blue crab populations have experienced a decline, earning shellfish a D grade. With a few exceptions, populations of finfish and colonial waterbirds in Galveston Bay appear to be holding steady. Twelve species of finfish identified as significant for either recreational fishing or food web relationships were found to be maintaining population levels, earning finfish a grade of C. Similarly, the majority of colonial waterbird species monitored earned a C for maintaining populations.

Note: Wildlife population studies and commercial seafood catch studies can reveal different trends. The Report Card looks at wildlife populations from an ecological standpoint (focusing on the relation of organisms to one another and to their physical surroundings). Various market or economic factors that are unrelated to the Bay's ecology can impact commercial catch data.

WHAT YOU CAN DO

Back the Bay by Keeping It Clean

VOLUNTEER:

Help build oyster reefs, participate in bird surveys, and remove debris like abandoned crab traps.

KNOW THE NESTS:

Get familiar with the popular nesting sites around the Bay — and keep your distance when birds are present.

REDUCE PLASTIC WASTE:

Keep track of your monofilament fishing line and hooks. Recycle monofilament line at designated locations. Refuse single-use plastic bags when you shop, and take your own reusable bags instead.

OBEY REGULATIONS: It is important to following fishing regulations, which are set with sustainable management of wildlife populations in mind. "Closed" seasons are often vital to providing a species the opportunity to successfully spawn the next generation, and catch limits are designed to prevent overfishing. For more information, visit the Texas Parks and Wildlife Department's Outdoor Annual site.

SHELLFISH

- Life in the Bay is interdependent. All plants and animals are connected through their roles in the food web.
- Trends in shrimp, crab and oyster populations are a good indicator of the quality and quantity of suitable habitat.
- Shellfish trends are also a good indicator for food availability for the rest of the ecosystem.

Galveston Bay Shellfish Grade: D (Requires Action)

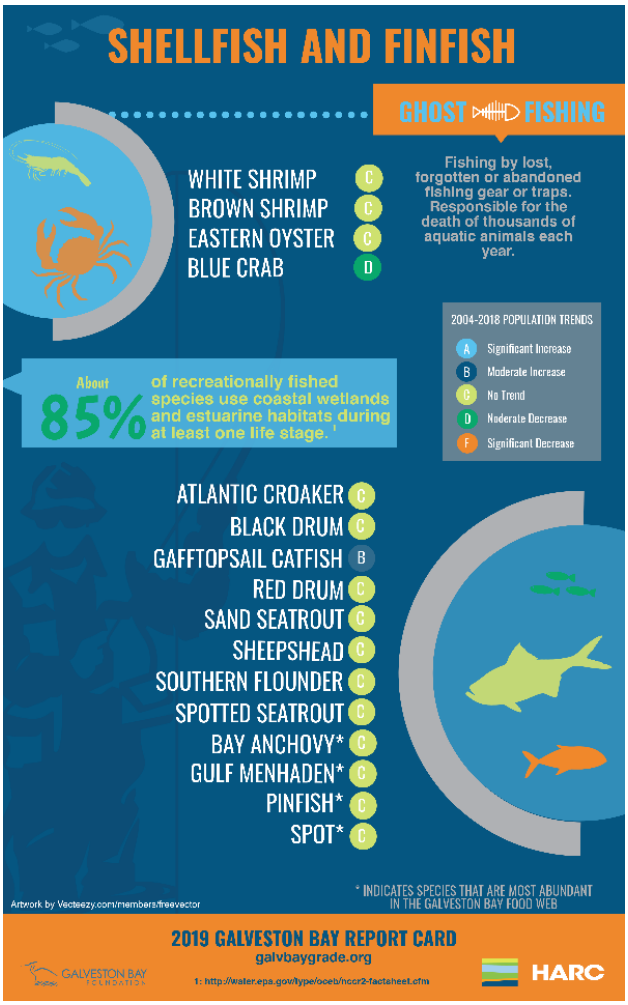
The species of shellfish analyzed for the report card included blue crabs, oysters, and two species of shrimp. Blue crab have seen a significant decline in past years, but recovered a bit in 2018, earning a grade of D for 2004-2018. White and brown shrimp appear to be maintaining their population levels. Oyster populations appear to be stabilizing as well and are recovering from the extreme drop in salinity after Hurricane Harvey. Rapid human population growth in the Galveston Bay/Houston region — which brings with it increased recreational and commercial use of the Bay, decreased habitat acreage, and increased stress on the system as a whole — has had a major impact on shellfish in Galveston Bay.

Photo by Steve Ford

See the Data

The Texas Parks and Wildlife Department (TPWD) Coastal Fisheries Division conducts fish surveys using several kinds of equipment: bag seines (nets deployed by hand) for catching smaller organisms in near-shore environments; bay trawls (nets deployed from the back of a boat, like on a shrimp boat) for collecting organisms found on or near the open bay bottoms; gill nets (large nets specialized for catching larger fish) near shore; and oyster dredges (specialized nets that remove oysters from the bay bottom) for sampling oyster reefs. The results we have shown are for bay trawl catch per unit effort (CPUE), which accounts for how long the trawl was deployed for each sample. We examined how catches for certain commercial, recreational, and important food web species have changed since 2004.

SHELLFISH



Grading scale

Grades were assigned by examining both the strength and direction of CPUE trends between 2004 and 2018. An R^2 value is a statistical measure of the strength of the trend. The higher the R^2 value, the stronger the trend.

Grade	Direction	R^2
A	Increasing	$R^2 \geq 0.5$
B	Increasing	$0.5 > R^2 \geq 0.25$
C	Stable	$R^2 < 0.25$
D	Decreasing	$0.5 > R^2 \geq 0.25$
F	Decreasing	$R^2 \geq 0.5$
I	(Insufficient data)	

WHAT YOU CAN DO

Help Keep the System Balanced

- Conserve water to protect freshwater inflows.
- Volunteer to remove lost or abandoned crab traps.
- Learn more about the decline in blue crab populations.

Freshwater inflows come into the Bay from the Trinity and San Jacinto rivers. They also come into the bayous and other tributaries that make up the Galveston Bay watershed. These inflows are extremely important to the success of our shrimp and oyster populations. Read more about the freshwater inflows indicator and what you can do to save water and save the Bay.

Blue crabs are a commercially valuable species, but their declining numbers have led to low annual harvests. Blue crabs are also important ecologically, and their low numbers affect predator and prey populations in the food web. The TPWD has introduced programs to buy back blue crab licenses and to remove lost traps in an effort to speed recovery of the blue crab population.

Learn more at the TPWD website.

FINFISH

- Galveston Bay is home to more than 100 species of finfish.
- Finfish in Galveston Bay make up a significant recreational fishery.
- Finfish populations have held steady since 2004.

The most common finfish species in the Bay include Atlantic croaker, bay anchovy, species of drum, seatrout, and species of catfish. Compared to shrimp, crabs and oysters, finfish make up only a small percentage of the commercially harvested seafood from Galveston Bay. They do, however, make up an economically significant recreational fishery. They also play an important role in the Bay and Gulf of Mexico ecosystems, serving as predator and prey for other species.

Galveston Bay Finfish Grade: C (Adequate for Now/ Maintaining)

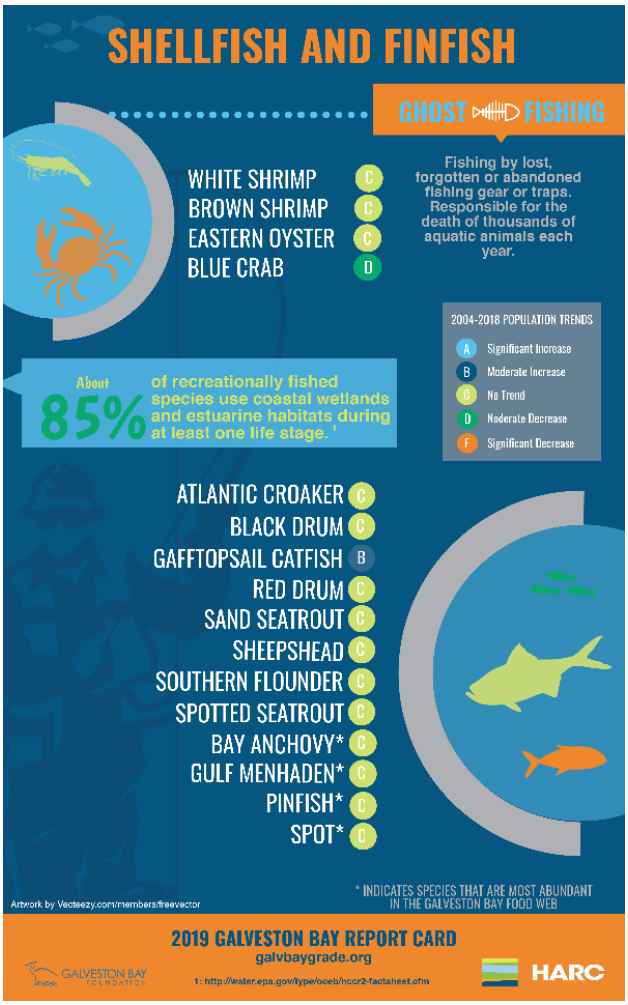
Finfish populations in Galveston Bay received a C for maintaining current levels since 2004. Gafftopsail catfish increased in Galveston Bay. It is worth noting that Gafftopsail catfish is included in the Seafood Consumption Advisory for Galveston Bay and the Houston Ship Channel as people should limit their consumption of all species of catfish caught in those areas.

Photo by Steve Clever

See the Data

The Texas Parks and Wildlife Department (TPWD) Coastal Fisheries Division conducts fish surveys using several different kinds of equipment: bag seines for smaller organisms in near-shore environments; bay trawls for collecting organisms found on or near the open bay bottoms; gill nets for catching larger fish near shore; and oyster dredges for sampling oyster communities on oyster reefs. The results we have shown are for bay trawl catch per unit effort (CPUE), which takes into account how long a trawl was deployed. We examined how catches for certain commercial, recreational, and important food web species have changed since 2004.

FINFISH



Grading scale

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Grade	Direction	R^2
A	Increasing	$R^2 \geq 0.5$
B	Increasing	$0.5 > R^2 \geq 0.25$
C	Stable	$R^2 < 0.25$
D	Decreasing	$0.5 > R^2 \geq 0.25$
F	Decreasing	$R^2 \geq 0.5$
I	(Insufficient data)	

WHAT YOU CAN DO

Help Keep the System Balanced

- Protect their habitat. Visit the Habitat page to learn more.
- Reduce pollution and slow your runoff with rain barrels, and use gravel instead of concrete.
- Report any evidence of a fish kill.

Many Bay and offshore fish species use the wetlands as a nursery for their young. Protecting critical habitat is vital to the ongoing success of finfish species in Galveston Bay and in the Gulf of Mexico. Visit the habitat page for more information.

Fish kills are a frequent occurrence on the Gulf Coast. Most fish kills can be attributed to our hot climate and high volume of urban runoff, which can cause eutrophic (low dissolved oxygen) conditions that can cause fish to die. If you see evidence of a fish kill, you can contact the Texas Parks and Wildlife Kills & Spills Team (KAST) at (281) 842-8100. KAST team members are trained to assess the impacts and to determine the causes of these events.

BIRDS

- Colonial waterbirds are heavily dependent on the quality and availability of nesting and feeding habitat. This makes them an excellent indicator of the Bay's overall health.
- The bird populations also depend on the populations of shellfish, finfish, and other organisms for food.
- Most bird populations in Galveston Bay have held steady since 2004.

Galveston Bay Bird Grade: C (Adequate for Now/Maintaining)

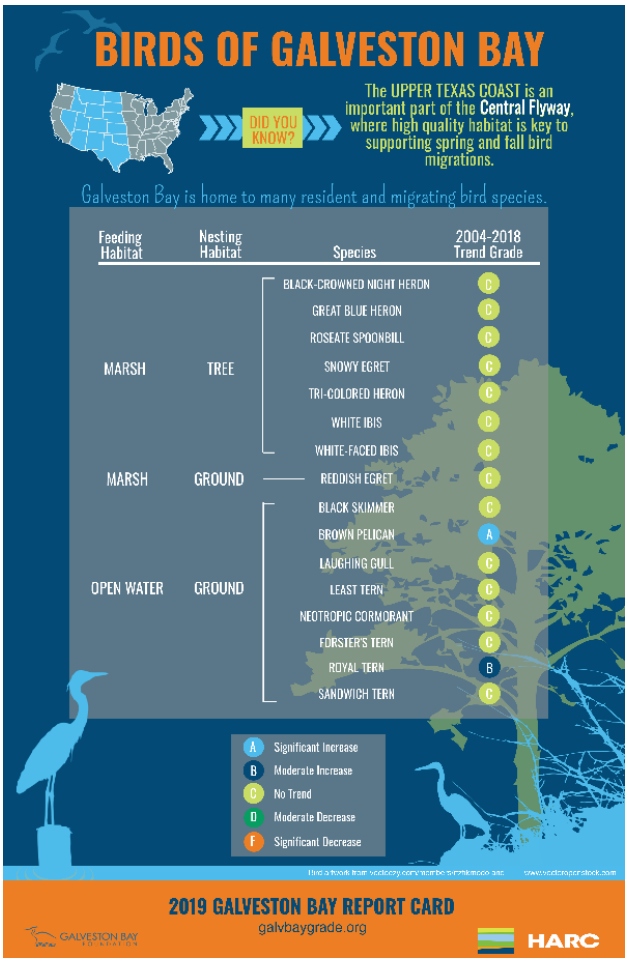
Bird populations in Galveston Bay received a C. Most populations monitored by the Texas Colonial Waterbird Society (TCWS; a coalition consisting of Audubon Texas, Coastal Bend Bays and Estuaries Program, Texas A&M University – Kingsville, Texas General Land Office, Texas Parks & Wildlife Department, The Nature Conservancy, U. S. Fish and Wildlife Service, U. S. National Park Service, and volunteers) have not shown either increases or decreases since 2003. Notable exceptions include a decline in black-crowned heron, a moderate increase in royal tern, and a significant increase in populations of brown pelican. Colonial waterbirds are widely distributed along the Texas Coast. Declines of a species in one Bay system may be offset by increases in that species in other Texas estuaries.

See the Data

Texas Colonial Waterbird surveys are conducted each year by staff of participating TWCS organizations and volunteers in May and June. The survey period corresponds to the summer nesting season, when colonial waterbird species come to the Texas Coast to raise their young. The survey estimates the number of nesting pairs of colonial waterbird species in rookeries or colonies along the Texas coast. This count excludes waterfowl and solitary nesters, but includes herons, egrets, gulls, terns, ibises and others. The report card compiles nesting pair numbers over all colonies in the lower Galveston Bay watershed to assess trends in abundance for the last 15 years.

Photo by Gene Fissler

BIRDS



Grading scale

Grades were assigned by examining both the strength and direction of CPUE trends between 2004 and 2018. An R^2 value is a statistical measure of the strength of the trend. The higher the R^2 value, the stronger the trend.

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D	Decreasing	$0.5 > R^2 \geq 0.25$
F	Decreasing	$R^2 \geq 0.5$
I	(Insufficient data)	

WHAT YOU CAN DO

Keep an Eye Out for Birds

- Join Houston Audubon for birding, advocacy, conservation, and education.
- Support legislation that prioritizes the preservation of natural nesting and feeing habitat for birds.
- Get to know birds' habitats on the Great Texas Coastal Birding Trail.

The Texas Coast is a magnet for bird watchers who come from all over the world to view species of waterbirds, waterfowl, raptors, and migratory songbirds. Houston Audubon is a great resource for birding in the Galveston Bay area, covering an 11-county region (which includes 17 sanctuaries). Audubon's mission is to advance the conservation of birds and positively impact their supporting environments. The organization offers a variety of advocacy, conservation and educational programs, as well as volunteer opportunities.

The Great Texas Coastal Birding Trail is a state-designated system of trails, bird sanctuaries, and nature preserves along the entire length of the Texas Gulf Coast. Maps are available online to guide you to the location of bird colonies, rookeries, and great birding habitat.

INVASIVE SPECIES

- Invasive species are species of plants, animals, fungi and microbes that come from other parts of the world and when introduced to new areas such as the Galveston Bay watershed, spread to a degree that causes environmental, economic or social harm.
- Invasive species degrade natural ecosystems, are destructive to infrastructure resulting in economic losses, and negatively impact outdoor recreational activities including boating, fishing, and hunting.
- Once introduced to new areas, invasive species are often very difficult and expensive to control and can be detrimental to crops, fisheries, forests, and other natural resources. Therefore, prevention of new introductions is key to stopping the spread of invasive species.
- The 84th Texas legislature approved $6.5 million to address the management of aquatic invasive species state-wide.

Galveston Bay Invasive Species Grade: B (Good)

Invasive species in the waters of Galveston Bay received a grade of B. Unlike some other bay systems around the country, Galveston Bay does not have a large invasive species problem. The rivers and bayous flowing into the Galveston Bay watershed, however, earned a grade of D as there are multiple invasive species that have become established and are causing problems. Invasive species include water hyacinth, Chinese tallow, grass carp, armored catfish, fire ants and the new-to-Texas zebra mussel, an invasive species documented previously in the Great Lake

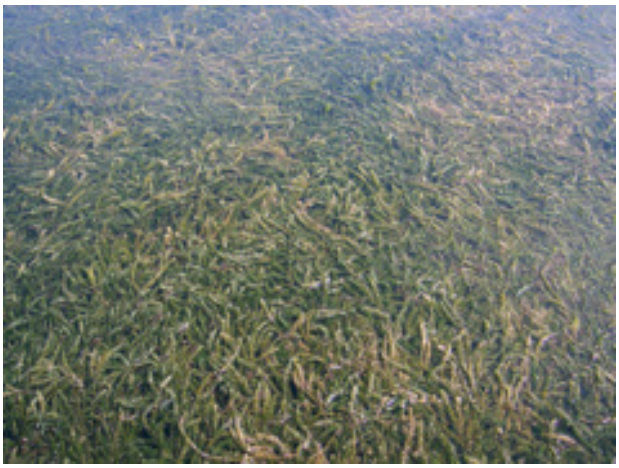


Photo by Earl Chilton, TPWD

FINFISH

See the Data

The USGS and Ladybird Johnson Wildlife Center's Texas Invasives Program maintain datasets of reported invasive species reported and verified throughout Texas. A number of new aquatic invasive species reported from 2004-2018 were evaluated for the Galveston Bay and rivers and bayous grade. The Galveston Bay Report Card also considers whether any of the reported species have become established and persist year after year. More information about invasive species in the Galveston Bay Watershed can be found at www.galvbayinvasives.org.

WHAT YOU CAN DO

If You Don't Know It, Don't Grow It

- Plant native plants when available and watch local nursery and pet store inventories for known invasive species.
- Remove invasive species from property, gear, equipment, boats and trailers (clean, drain and dry)
- Join a local invasive species removal effort or citizen science program.

Photo by Earl Chilton, TPWD

HABITAT

2019 GALVESTON BAY REPORT CARD

WWW.GALVBAYGRADE.ORG

#galvbaygrade19

HABITAT

Photo by Anja Borski

SUMMARY

- Galveston Bay and its watershed contain several habitat types.
- The variety of Bay habitats contributes to the biodiversity of the Houston-Galveston region.
- Three of the 4 key coastal habitats assessed for the report card are currently under stress.

D

OVERALL HABITAT GRADE

Galveston Bay and its watershed contain a wide variety of important habitat types, ranging from open water areas and sand flats, to seagrass meadows, oyster reefs, bird islands, fringing saltwater wetlands, freshwater wetlands, and coastal prairie.

Regional habitats support numerous plant, fish, and wildlife species, so these habitats contribute tremendously to the biodiversity found in the Houston-Galveston region. The protection and restoration of diverse and abundant natural habitats is a requirement for the preservation of the biodiversity and ecological functions of Galveston Bay.

The various habitats found within Galveston Bay's watershed also provide goods (like seafood) and services (such as storing nutrients and cleaning water) that enhance and support the quality of life for people living and working in our region. Protecting and restoring habitat is vital to the future health of the Bay and the area's residents.

Making the Grade

Many of the habitats in Galveston Bay and its watershed are under stress. Freshwater wetlands, oyster reefs and underwater grasses (seagrass) have seen significant declines over the years. Collecting accurate habitat data takes time and considerable effort. As a result, it is often not possible to gather new habitat data on a yearly basis. Data describing wetland habitats are supposed to be updated every five years; the next update of the National Oceanic and Atmospheric Administration's Coastal Change Analysis Program (NOAA C-CAP) wetlands dataset was expected in late 2016, but has not yet been updated for Texas. For the 2019 grade, we used 2015 Houston-Galveston Area Council (H-GAC) data for development in the region combined with the 2010 NOAA C-CAP data to estimate wetland loss for 2015*. The 2019 wetlands grades appear with an asterisk (*) to denote that this grade is an estimate. Data describing the extent of habitats including oyster reefs and underwater grasses are gathered by state agencies such as the Texas Parks and Wildlife Department are being processed. The Galveston Bay Report Card habitat grades will be updated as new data are obtained.

WHAT YOU CAN DO

Back the Bay by Keeping It Clean

VOLUNTEER: Restore habitat around Galveston Bay by joining an organization or taking part in events such as Marsh Mania, where people plant cordgrass.

STAY INFORMED: Be aware of proposed construction and dredging projects that could impact natural habitats in and around Galveston Bay. Also, participate by submitting comments during public review periods. A list of public review documents is available at the U.S. Army Corps of Engineers Galveston District website.

- Each year, the Galveston Bay Foundation's Wetland Permit Review Committee examines approximately 100 public notices from the U.S. Army Corps of Engineers for wetland permit applications. The committee makes recommendations for changes or denials when the projects do not appear to meet applicable regulations or mitigation requirements — or do not represent the least environmentally damaging alternative. For additional information about the GBF's Wetland Permit Review Committee and opportunities to get involved, visit the Galveston Bay Foundation's website.

CONSERVE LAND: Private landowners can consider donating land or establishing conservation easements as two ways to conserve natural resources. These protect the land from development for perpetuity while retaining ownership. Donors of land or easements can often take advantage of federal tax incentives for the value of their donation. Learn more about aquatic habitat conservation here.

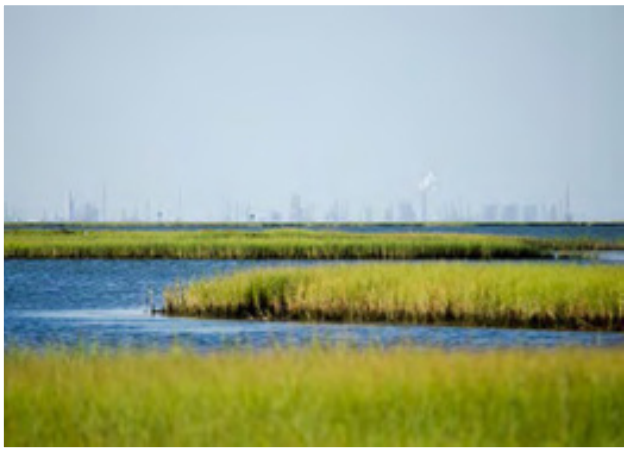
WETLANDS

- Wetlands are found at the transition between land and aquatic environments.
- Wetlands are a natural filter for runoff. They also slow tides and storm surges, and reduce shoreline erosion.
- Saltwater wetland acreage is currently maintaining, but freshwater wetland acreage is declining.

Found at the transition between land and aquatic environments, wetlands can be salty, brackish, or fresh, and can be either constantly or intermittently flooded. Wetlands naturally filter polluted runoff coming from land, storing and processing nutrients as they flow toward the Bay. Wetlands also serve as a buffer for tides and storm surges, reduce shoreline erosion, and offer recreational opportunities. Biologically, wetlands are an important source of nutrients for the aquatic food web, and they serve as an important habitat for many species of fish, birds, and other wildlife, especially those in juvenile stages of life.

Overall Saltwater Wetlands Grade: D* (Requires Action)

Overall Freshwater Wetlands Grade: D* (Requires Action)



Between 1953 and 1989, the Galveston Bay watershed lost more than 30,000 acres of freshwater and saltwater wetlands. In just 20 years (1996 to 2015*), the Galveston Bay system lost an additional 8,206 acres of saltwater wetlands and 80,173 acres of freshwater wetlands (a total of 10 percent of all wetlands across the region) to development. In order for wetlands to effectively prevent flooding, filter water, and provide habitat for the entire Galveston Bay system, they need to be present all around Galveston Bay. The disappearance of wetlands from a large portion of Galveston Bay means that our area is more vulnerable to flooding and water quality issues. Wetlands are an extremely valuable and threatened resource, and keeping track of our region's wetlands is vital to their protection. Wetland coverage maps are usually released by NOAA every five years, but have not been updated for Texas since 2010. For the 2019 grade, we used 2015 Houston-Galveston Area Council (H-GAC) data for development in the region combined with the 2010 NOAA C-CAP data to estimate wetland loss for 2015*. The 2019 wetlands grades appear with an asterisk (*) to denote that this grade is an estimate.

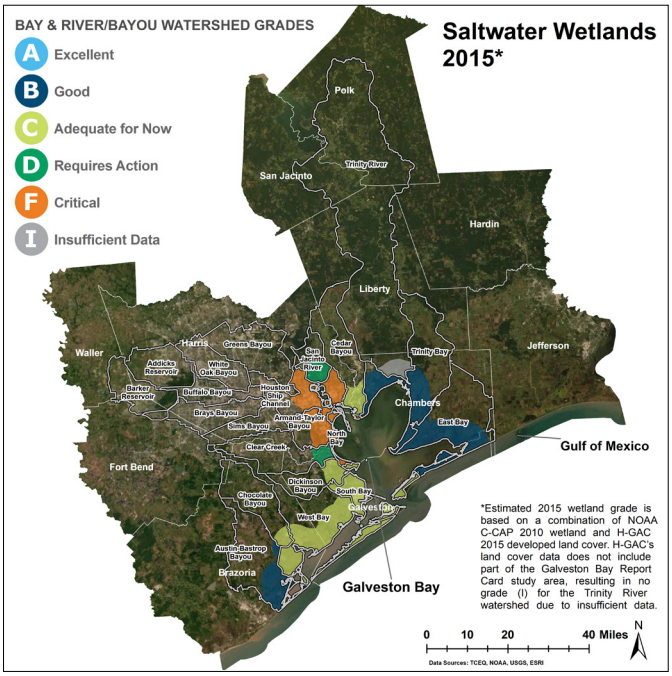
Some wetlands are difficult for the average person to identify; they may not look "wet" all of the time. But that doesn't mean that they aren't valuable. There are two major categories of wetlands around Galveston Bay. One type, called saltwater or fringing wetlands, occurs where saltwater from the ocean mixes with freshwater from land. The second type, called freshwater or palustrine wetlands, are found further inland, often embedded in coastal prairie or forested habitats.

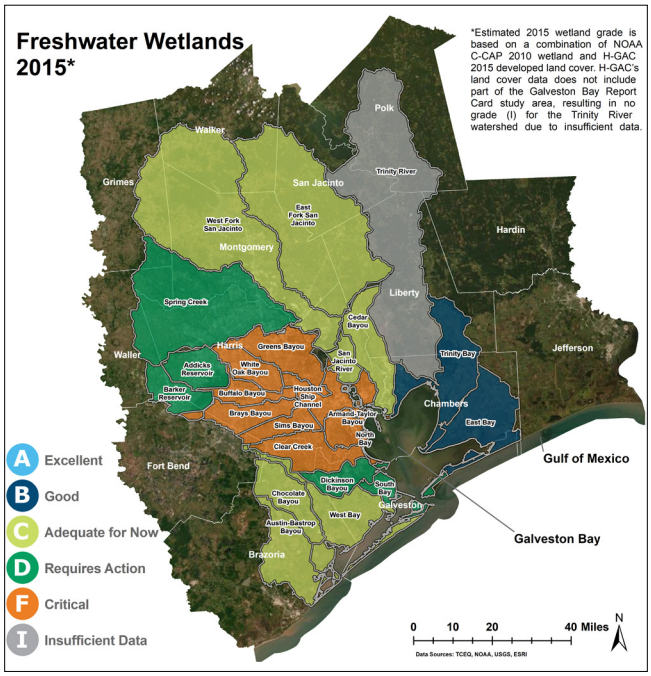
WETLANDS

Runoff from impervious surfaces like concrete parking lots and roads can alter the plant community and impact the basic services provided to animals that rely on wetland habitats. Wetlands can be permanently damaged by disturbances such as clearing and draining, the placement of permanent and temporary structures, and driving vehicles through soft soils.

Under the Clean Water Act, construction in, and alteration of, saltwater wetlands requires a permit, and is regulated by the U.S. Army Corps of Engineers. But many freshwater wetlands remain unprotected from development, and continue to be lost at a greater rate than which they are being restored or preserved.

See the Data





Saltwater wetland loss by subwatershed graphic legend:

Subwatersheds of Galveston Bay are shaded according to wetland loss grade. Saltwater wetlands are located on the fringe of tidal waters and land. The wetland maps only show wetland loss between 1996 and 2015*. Wetlands lost before 1996 are not shown.

Freshwater wetland loss by subwatershed graphic legend:

Subwatersheds of Galveston Bay are shaded according to wetland loss grade. Freshwater wetlands include prairie potholes, freshwater swamps, wetlands along nontidal rivers and streams, and seasonal wetlands. The maps only show wetland loss between 1996 and 2015*. Wetlands lost before 1996 are not shown.

*Estimated 2015 wetland grade is based on a combination of NOAA C-CAP 2010 wetland and H-GAC 2015 developed land cover. H-GAC's land cover data does not include part of the Galveston Bay Report Card study area, resulting in no grade (I) for the Trinity River watershed due to insufficient data.

WETLANDS

Wetland coverage was calculated using the National Oceanic and Atmospheric Administration (NOAA) Coastal Change Analysis Program (C-CAP) data set. Change from wetland to developed land uses (residential and commercial development) between 1996 and 2015* was used to calculate percent of wetland loss. For the 2019 grade, we used 2015 Houston-Galveston Area Council (H-GAC) data for development in the region combined with the 2010 NOAA C-CAP wetland data to estimate wetland loss for 2015*. As there is no comparable baseline to use for historic wetland loss, percent of wetland loss and percent of developed land in the subwatershed were averaged to come up with a composite wetland loss grade for each subwatershed. The 2019 wetlands grades appear with an asterisk (*) to denote that this grade is an estimate.

Grading Scale

We created our composite wetland loss grading scale after consulting with coastal and wetland scientists and considered the impact of wetland loss on the Galveston Bay system as a whole.

Grade	% Loss
A	0%
B	1-9%
C	10-25%
D	26-50%
F	51-100%
I	Incomplete

WHAT YOU CAN DO

Choose Conservation

- Join a wetland restoration effort.
- Stay informed about development projects that threaten wetlands.

Flooding and water quality affects all citizens of the Galveston Bay region; therefore, wetland loss does too. Wetland loss is a serious issue around the United States. In 1988, President George H. W. Bush adopted a national goal of “no net loss” of wetlands. That goal continues, but every year more wetlands are lost, mostly to development.

HARC engaged in a study of the long-term status of wetland permit and mitigation activities in the Lower Galveston Bay watershed. The goal of the study is to determine how to better bridge the gap between development, land use permitting decisions made by local governments, the federal wetland permitting process, and regional habitat conservation goals.

UNDERWATER GRASSES

- Underwater grasses grow in shallow, clear water.
- Underwater grasses are an important habitat for juvenile species of fish and shellfish.
- The acreage of seagrass habitat has significantly declined.

Underwater grasses, or seagrasses, grow in shallow areas of the Bay with clear water. This lets light penetrate the surface, allowing the grass to perform photosynthesis. Like wetlands, seagrass beds are an important habitat for juvenile species of fish and shellfish.

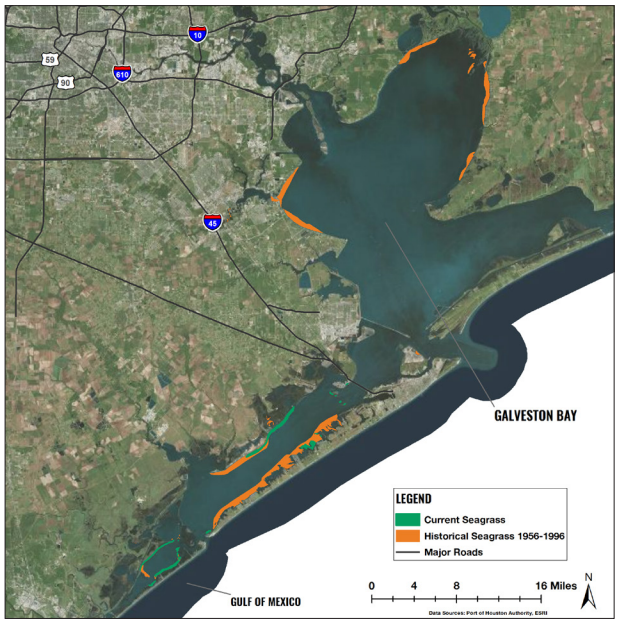
Photo by Anja Borski

Overall Underwater Grasses Grade: C (Adequate for Now)

Underwater grasses have largely disappeared from Galveston Bay, with the exception of Christmas Bay. In 1996, the Galveston Bay Plan set a goal of 1,400 acres of seagrass restoration within 10 years. Since 1996, 2,218 acres of seagrass have been restored in the Galveston Bay system, but another 342 acres have been lost, resulting in a net gain of 1876 acres of seagrass in Galveston Bay since 1996. The goal set by the Galveston Bay Plan for 2006 has been achieved, but a new goal for Galveston Bay is needed. We hope that continued restoration efforts and improving water quality, will help this valuable habitat recover.

See the Data

The Texas Parks and Wildlife Seagrass Viewer shows the current extent of seagrasses in coastal Texas bays, including Galveston Bay. In order to grade Galveston Bay's seagrass acreage, we used the TPWD's seagrass map. We also added acreage near Carancahua Cut using new aerial photographs provided by the Galveston District of the U.S. Army Corps of Engineers. We then compared the total current seagrass coverage to the Galveston Bay Plan's goal of 1,400 acres of restored seagrass.



UNDERWATER GRASSES

Grading Scale

We created our composite wetland loss grading scale after consulting with coastal and wetland scientists and considered the impact of wetland loss on the Galveston Bay system as a whole.

Grade	% Restoration
A	81-100%
B	61-80%
C	41-60%
D	21-40%
F	0-20%
I	Incomplete

WHAT YOU CAN DO

Keep the Water Clear

- Prevent nutrient pollution by using rain barrels, picking up after your pets, and following fertilizer directions carefully.
- Be a responsible boater and never allow propellers or paddles to come into contact with seagrass beds.
- Speak up for responsible dredging practices.

Underwater grasses are an excellent indicator of ecosystem health, since so many factors contribute to their success or failure. For more information about the aspects of Bay health that impact underwater grasses, be sure to read about water quality issues like poor water clarity caused by too much nitrogen and phosphorus; salinity changes due to variability in freshwater inflows; and habitat loss due to sea level rise.

Progress has been made in recent years to move away from old practices of open-bay disposal. These practices deposited dredge material on valuable underwater habitats like seagrass meadows and oyster reefs. Today, a network of partners around the region works to identify dredge disposal locations that support beneficial uses in Galveston Bay. Dredge material is tested and used to restore habitats such as bird islands, as well as associated habitats, such as sand flats and wetlands.

Learn more about seagrass in Texas and access educational materials about seagrass-friendly boating.

OYSTER REEFS

- Oysters filter silt and contaminants from Galveston Bay, improving water quality and clarity.
- Galveston Bay was once filled with oyster reefs, but only a fraction remains due to the over harvesting of oyster shells, damaging storms, drought, fishing pressure, and disease.
- The most recent oyster reef maps available are outdated (1994), and the current status of oysters cannot be evaluated, so the grade for oyster reefs is an I for Incomplete.

As generations of oysters grow on top of each other, they form reefs that provide habitat for many other animals. Oysters are capable of filtering as much as 50 gallons of water each in a single day, removing silt and contaminants from the water, and improving local water quality and clarity. Galveston Bay was once filled with oyster reefs, but we only have a fraction of them left because of the over harvesting oyster shells for construction material (a practice that is now prohibited), damaging storms, fishing pressure, and disease.

Photo by Chris Kuhlman

Galveston Bay oysters are also an important commercial fishery. Oysters are monitored closely for signs of stress because of changes in salinity (the salt content of the water). These changes occur due to fluctuations in the amount or timing of freshwater flowing from the Trinity and San Jacinto rivers, especially during times of drought. Prolonged periods of saltier water can cause predators and parasites to overwhelm oysters' natural defenses. The good news is that because of their biological and economic importance, a lot of work is being done to restore oyster reefs in Galveston Bay.

Overall Oyster Reefs
Grade: I (Incomplete)

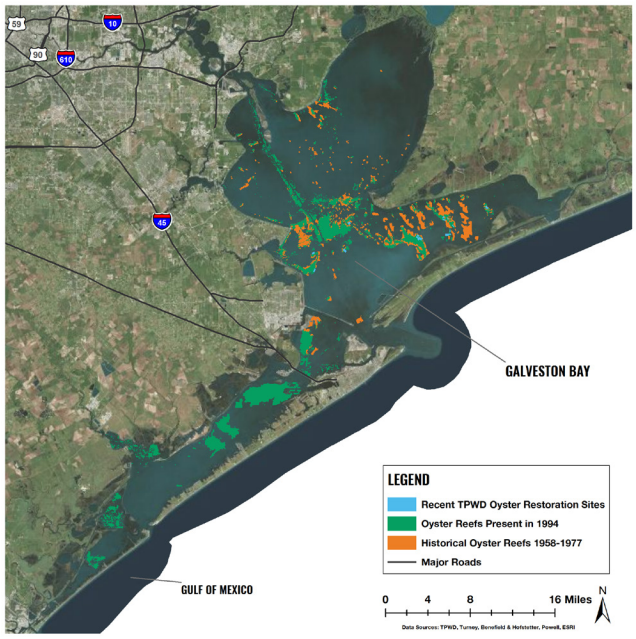
Historically, oyster reefs in Galveston Bay covered large areas, especially near Red Fish Bar (which once extended across the middle of the Bay, from Eagle Point to Smith Point), in East Bay, and in West Bay. Oyster reef area has decreased over the last decade due to three primary factors: coastal storm surges, drought, and fishing pressure.

Fishing pressure for oysters has increased along with oyster's popularity on restaurant menus. In an effort to keep oysters from being over harvested and disappearing from the Bay completely, the State of Texas stopped issuing new commercial oyster licenses in

OYSTER REEFS

2007, but that could not protect the oysters from the natural disasters ahead. The Texas Parks and Wildlife Department (TPWD) estimates that approximately 60 percent of oyster reefs in Galveston Bay were buried in sediment transported by the storm surge caused by Hurricane Ike in 2008. The drought of 2011-2012 took a further toll on Galveston Bay's oyster reefs. Freshwater inflows to Galveston Bay were severely limited and salinities became unusually high throughout the Bay leading to a higher incidence or parasites and disease. Major flood events like Hurricane Harvey can also negatively impact oyster reefs if low salinities persist long enough to stress oysters past their ability to recover.

The most recent oyster reef maps available are from 1994, yet significant loss since that time is irrefutable, especially since Hurricane Ike in 2008. While limited data describing recent oyster restoration projects led by the TPWD exist, we cannot report accurately on the current coverage of oyster reefs in Galveston Bay.



See the Data

Map data describing the distribution of oyster reefs in Galveston Bay were created in 1994 and are therefore extremely out of date. However, the TPWD is in the process of finalizing new oyster reef mapping information. TPWD coastal fisheries monitoring data also indicate that oyster abundance has declined in Trinity Bay, East Bay, and Upper and Lower Galveston Bay, confirming preliminary oyster reef distribution data from the agency.

WHAT YOU CAN DO

Keep an Eye Out for Birds

- Volunteer to rebuild oyster reefs, or help oyster populations through the oyster gardening program for waterfront property owners.
- Speak with your favorite restaurant about shell recycling.
- Learn more about oyster reef habitat from the National Oceanic and Atmospheric Administration (NOAA).

You can help oysters in Galveston Bay by volunteering to restore oyster reefs, assisting with shell recycling from restaurants, or increasing oyster populations through the oyster gardening program for waterfront property owners.

Learn more about Galveston Bay's Eastern Oysters here.

HUMAN HEALTH RISKS
2019 GALVESTON BAY REPORT CARD

WWW.GALVBAYGRADE.ORG
#galvbaygrade19

HUMAN HEALTH RISKS

Photo by Chris Kuhlman

SUMMARY

- Many types of Galveston Bay seafood are safe to eat, however toxic contamination in the Bay has led to seafood consumption advisories for some species in certain areas.
- Streams and bayous that flow into the Bay frequently have high levels of bacteria that indicate the presence of microorganisms that can make humans sick via consumption of oysters or contact with water.
- The Clean Water Act of 1972 initiated great improvements to Galveston Bay. However, today's advisories indicate that there's work to be done.

C

OVERALL HUMAN HEALTH RISKS GRADE

In the early 1970s, the Clean Water Act set a national goal for the country's bodies of water to be swimmable and fishable. However, toxic and bacterial contamination in Galveston Bay has triggered the implementation of advisories concerning the consumption of certain kinds of seafood, and limits oyster harvesting in specified locations. When pollution such as oil or chemicals is found in the sediment at the bottom of the Bay, it can be ingested by animals like fish and crabs. Pregnant women and children, in particular, who eat those animals then have a higher risk of adverse health effects.

Making the Grade

Some areas, especially the bayous upstream of the Bay, are frequently impaired by high levels of bacteria. That means there may be other bacteria or viruses that can make swimmers, anglers, or boaters sick if the waters are ingested or come in contact with an open wound. Great improvements have taken place since the implementation of the Clean Water Act. But the advisories in place today are evidence that work still needs to be done to improve conditions so that future generations can continue to swim and fish in Galveston Bay.

WHAT YOU CAN DO

Keep Galveston Bay Clean

OBSERVE SEAFOOD ADVISORIES

- Many types of Galveston Bay seafood — including fish, shrimp, crabs, and oysters are safe to eat. But toxic pollutants or bacteria can pose a threat to human health when they accumulate in the tissues of the animals we eat.
- Children and pregnant women are at the greatest risk for illness from contaminated seafood.
- Avoiding or limiting consumption of species included in the advisories, and varying the location and type of seafood you eat, are easy ways to lower your risk from contaminated seafood. Learn more.

CEASE THE GREASE

- Fats, oils, and grease (FOG) poured down the sink can condense and clog pipes and sewer lines below our feet. About 50 percent of sewer overflows are caused by FOG, which release untreated sewage into the environment and pollute Galveston Bay with harmful bacteria.
- The Galveston Bay Foundation's Cease the Grease program aims to educate people on the issue. Learn more.

BOAT CLEANLY

- Sewage from boats is one of the primary sources of fecal bacteria in Galveston Bay. In spite of having several pump-out facilities in the area, many boaters continue to dump raw sewage directly into our waters due to a lack of enforcement and understanding about the potential impacts.
- The Galveston Bay Foundation's Pump Don't Dump program aims to educate boaters about the issue. Learn more.

MAINTAIN SEPTIC TANKS

- If your home is not connected to a municipal sewer, you will have a septic tank, or on-site sewage facility (OSSF). It is important to ensure that your OSSF is functioning properly to avoid contaminating the environment with harmful bacteria. Learn more.

SEAFOOD CONSUMPTION

- Toxic contaminants enter the food web through biomagnification — the progressively increasing concentration of toxic substances such as polychlorinated biphenyls (PCBs) or mercury as they move up the food chain.
- Approximately 50 percent of Galveston Bay is currently classified as a prohibited or restricted harvest zone for oysters, indicating a significant risk to human health.
- The state of advisories in Galveston Bay has not changed significantly in recent Years.

Toxic contaminants work their way into the food web through biomagnification. Plants, microorganisms, and animals that live in the sediment or on the Bay bottom, absorb contaminants first. They are consumed in turn by larger organisms, which are consumed by even larger organisms. Some toxins pass out of the animals' bodies, but others have a tendency to accumulate, especially in the fatty tissues.

Bacteria are another topic of concern for seafood, specifically oysters. Bacteria screening levels set for oyster harvesting are more stringent than those for contact recreation like swimming, because bacteria can accumulate in oysters and other shellfish. This makes them unsafe to eat, especially if consumed raw.

Galveston Bay Seafood Consumption Advisories Grade: C (Adequate for Now)

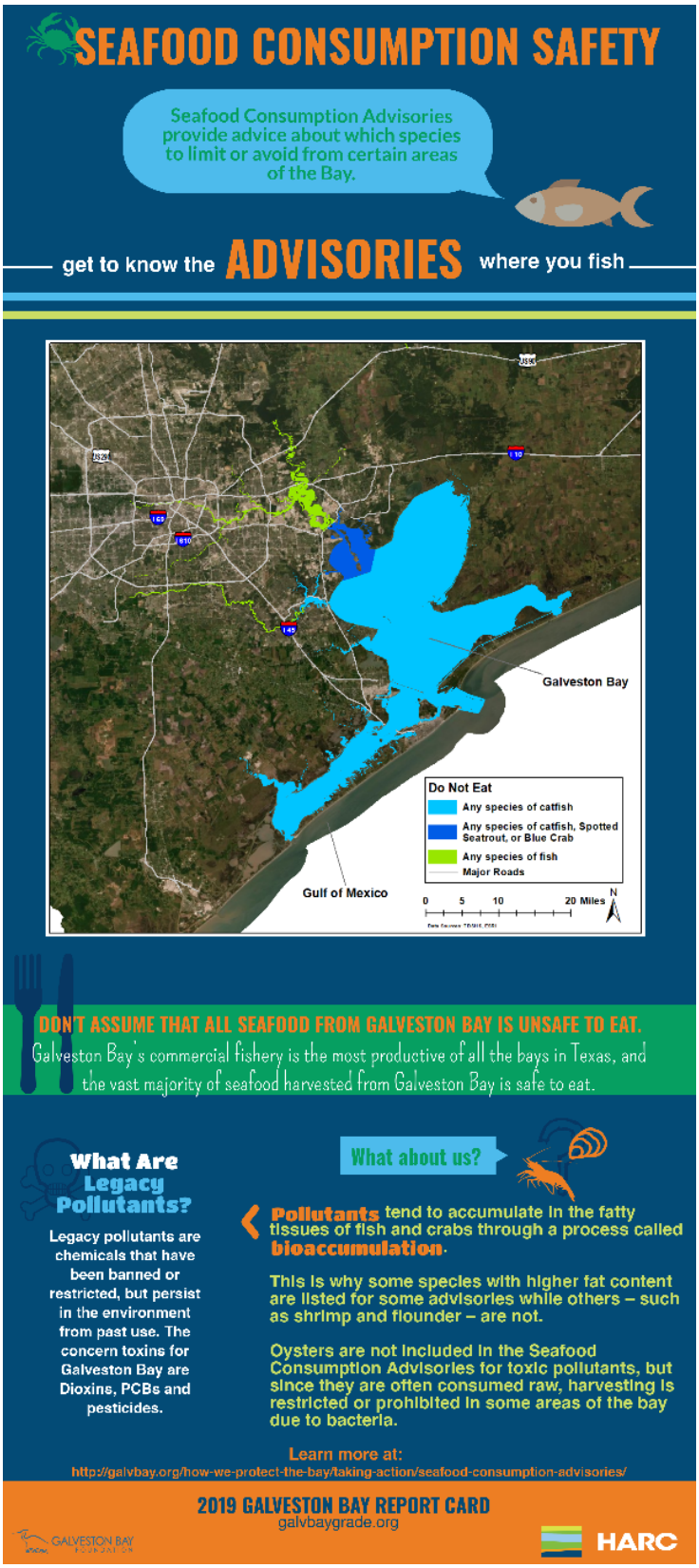
Rivers and Bayous Seafood Consumption Advisories Grade: D (Requires Action)

Photo by Chris Kuhlman

The Texas Department of State Health Services issues Seafood Consumption Advisories. Advisories are updated as new data are made available, and may be issued after a specific incident. At the time of this report, advisories covered five geographic areas of the Bay, each having its own set of affected species. Pollutants listed in the advisories include PCBs, dioxins, and pesticides.

The Seafood Consumption grade in Galveston Bay remains a C because the current state of advisories has remained stable for several years. We awarded Seafood Consumption from rivers and bayous a D because advisories in the rivers and bayous of Galveston Bay increased in 2015 and has not been resolved. We are concerned that limited and irregular funding for testing fish for contaminants may be under-representing the extent of regional threats to healthy seafood.

SEAFOOD CONSUMPTION



The most commonly impaired use of Texas coastal waters is “oyster waters use,” or the areas of the Bay from which oysters are harvested. While there are not currently any consumption advisories for oysters, approximately 50 percent of Galveston Bay is classified as prohibited or restricted harvest zones, indicating significant risk to human health. Restrictions can reflect closures due to high rainfall and runoff, extreme weather conditions, oil or chemical spills, harmful algal blooms, or the failure or inefficient operation of wastewater treatment facilities. The Texas Commission on Environmental Quality (TCEQ) has adopted a Total Daily Maximum Load (TMDL) for Galveston Bay’s oyster waters, a scientifically derived target that tells us the greatest amount of a particular substance that we can add to a waterway and still keep it healthy. This helps improve water quality so that the oyster beds remain safe for harvesting.

See the Data

Fish samples are collected and fish tissue is tested for a variety of contaminants, including metals, pesticides, PCBs, and others. The criteria levels that trigger the issuance of Seafood Consumption Advisories are meant to protect vulnerable populations, especially children and women of childbearing age. The advisories also differ depending on the species caught and their locations. See a full listing of all Texas advisories, bans, and cancelled orders.

SEAFOOD CONSUMPTION

Grading Scale

The current advisories from the Texas Department of State Health Services represent the best available data for Galveston Bay. In our best professional judgment, this information is adequate for the current conditions in the Bay, earning a “C” grade. The rivers and bayous of Galveston Bay are the areas of greatest concern for seafood contamination.

WHAT YOU CAN DO

Choose Conservation

- Stay informed about and support cleanup efforts that protect the Bay and its bounty, such as the cleanup of the San Jacinto River Waste Pits.
- Participate in the various workgroups for the Galveston Bay Bacteria Reduction Plan.
- Learn more about Seafood Consumption Advisories and pay attention to where you fish and what you eat.

Don’t assume that all seafood from Galveston Bay is unsafe to eat. Galveston Bay’s commercial fishery is the most productive of all the bays in Texas, and the vast majority of seafood harvested from Galveston Bay is safe to eat. Recreational fishermen harvest prized seafood species such as flounder, red drum, and speckled trout. Consult the Seafood Consumption Advisories for advice about which species to avoid from certain areas of the Bay.

The U.S. Environmental Protection Agency is overseeing the cleanup of the San Jacinto River Waste Pits (SJRWP), where the Champion Paper mill dumped waste in the 1960s. The SJRWP, located where the mouth of the San Jacinto River and I-10 cross, east of Houston, are a source of dioxins in Galveston Bay. Dioxins cause increased risk of cancer and other threats to human health, including liver damage and birth defects.

In an effort to address bacteria impairments, the Galveston Bay Foundation (GBF) has worked with stakeholder groups and the Texas Commission on Environmental Quality (TCEQ) to help develop the Upper Gulf Coast Oyster Waters Total Maximum Daily Load (TMDL) and the Bacteria Reduction Plan. The TMDL determines the amount of bacteria that Galveston Bay can receive and still support oyster harvesting, and the Galveston Bay Bacteria Reduction Plan outlines strategies to reduce bacteria levels and improve the safety of oyster harvesting.

RECREATION

- Bacteria and viruses from the waste of humans, other mammals, and birds that live in the Bay watershed can cause illness or infection in those who come into contact with the water.
- Today's high concentrations of people and pets, and an aging sewage infrastructure, have resulted in too much bacteria in some regional waterways.
- In 2018, swimming in the Bay remained safe, but swimming in many of the region's streams and bayous is discouraged due to recurring high levels of bacteria.

Bacteria and viruses in our waterways can cause swimmers and others who may come into contact with contaminated water to become ill or suffer from infections. The harmful microorganisms causing these problems come from humans and other warm-blooded animals, including both domestic and wild mammals and birds. It is natural to find bacteria and viruses in the environment. However, today's combination of high concentrations of people and pets living along the coast, aging sewer infrastructure, and other changes has resulted in far more bacteria in waterways than the ecosystem can handle.

Galveston Bay Water Recreation Safety Grade: A (Excellent)

Galveston Bay Rivers and Bayous Grade: B (Good)

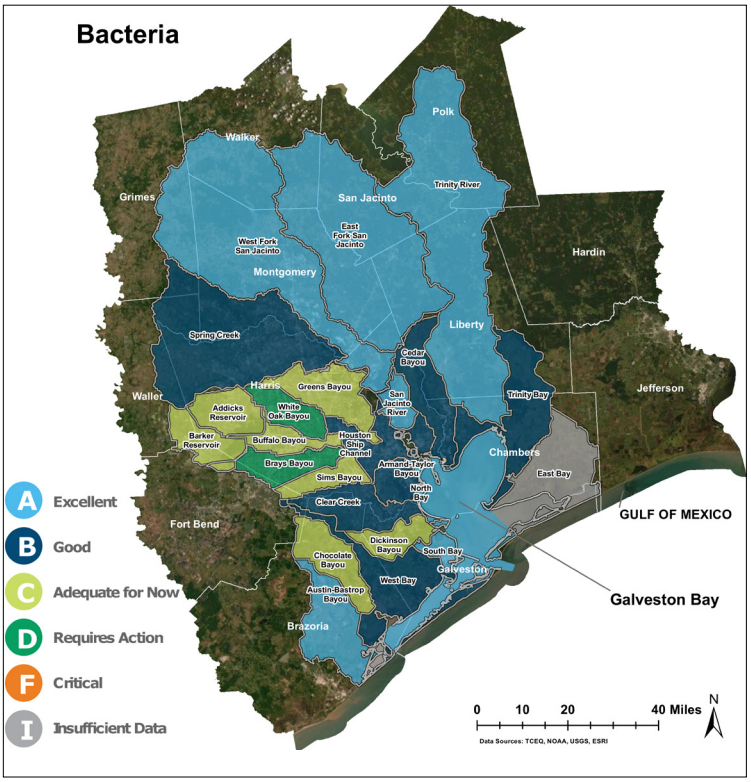
Photo by Gene Fissler

In 2018, bacteria concentrations exceeded screening levels in only 12 percent of samples collected from Galveston Bay, indicating that the risk of bacterial infection while swimming in its open waters remained low yielding the grade of an A. Additionally, the rivers, streams and bayous grade received a B for the second year in a row. Of the 25 watersheds included in the Report Card, one watershed saw some improvement compared to last year's grades. Nineteen watersheds saw no change, while three watersheds (Dickinson Bayou, Chocolate Bayou, and West Bay watershed) degraded. A number of watersheds received A's. However, swimming in certain rivers, streams, and bayous upstream from Galveston Bay may be discouraged, as 24 percent of samples collected in these urban and suburban areas still exceeded screening levels in 2018. Check the map of High Swim Risk Watersheds below.

RECREATION

Water Recreation Safety Combined Bacteria graphic legend:

In the map of the Galveston Bay region, Galveston Bay and its sub watersheds are colored according to their grade for bacteria. A sub watershed is the area of land where all of the water drains into a body of water that, in turn, flows into Galveston Bay. Each Galveston Bay sub watershed is labeled with its name (e.g., Buffalo Bayou WS). The water in the bay, river, or bayou is tested for bacteria, but the entire sub watershed is shaded to show the grade since the bacteria come from the watershed as a whole.



The water recreation safety grade in the Galveston Bay Report Card is based on bacteria levels in water. Galveston Bay and its rivers and bayous are monitored by the TCEQ for recreational safety using bacteria levels as indicators of human and animal waste that might cause disease.

E. coli concentrations were compared to 2018 TCEQ recreational-use, single-sample screening levels set at 399 colonies/100mL for freshwater segments. Enterococcus concentrations were compared to 2018 TCEQ recreational-use, single-sample screening levels set at 130 colonies/100mL for saltwater. Samples collected by the Texas General Land Office's Texas Beach Watch Program at Galveston Island State Park, Texas City Dike, and Sylvan Beach were included in this grade using Texas Beach Watch's single- sample screening level of 104 colonies/100 mL. Grades are based on the number of samples collected in 2018 exceeding the above screening levels.

RECREATION

Grading Scale

The grading scale for water recreation safety is based on the quintile-grading scheme used for water quality parameters.

Grade	% Exceedance
A	0-20
B	21-40
C	41-60
D	61-80
F	81-100
I	(insufficient data)

WHAT YOU CAN DO

Keep Galveston Bay Fun

- Pick up after your pets and properly dispose of pet waste in the trash.
- Volunteer for the Water Quality Monitoring Team.
- Check beach conditions before heading out to play in the Bay.

Water samples tested immediately following rain events often show a spike in bacteria levels. Storm water can cause wastewater treatment facilities and septic system overflows. Storm water can also wash animal waste into streams, rivers, bayous, and the Bay. Investments in wastewater treatment infrastructure are needed to improve water recreation safety. Also, everyone with pets can do their part by picking up and properly disposing of animal waste.

The Galveston Bay Foundation's Water Quality Monitoring Team is composed of more than 50 volunteers who are specially certified as bacteria samplers. These samplers collect a small amount of water to be tested for a type of fecal indicator bacteria (enterococcus). Testing is completed at the Galveston Bay Foundation's Bacteria Monitoring Lab by a specially trained volunteer and GBF staff. See their sampling results and learn about how you could join the team.

Bacteria in Streams and Bayous: See the 2018 Basin Highlights on Basins from the Houston-Galveston Area Council.

Beach Conditions: When you are thinking about heading out to play in the Bay, check the Texas General Land Office's Texas Beach Watch website for the latest bacteria test results at three locations: Sylvan Beach in La Porte, the Texas City Dike, and the bay side of Galveston Island State Park.

COASTAL CHANGE
2019 GALVESTON BAY REPORT CARD

WWW.GALVBAYGRADE.ORG
#galvbaygrade19

COASTAL CHANGE

Photo by Port of Houston Authority

SUMMARY

- Coastal change and resilience of coastal communities to hazards such as storms, rising sea levels and drought have become a global priority.
- Although plants and animals are able to adapt to their ever-changing physical environment, they may not be able to adapt to rapid changes associated with rising sea levels, increasing temperatures, acidification of waters, and declining amounts of freshwater.
- While water temperatures and pH appear to be maintaining, the rate of sea level rise and increases in human freshwater use are concerning for the future of the Bay.

OVERALL GALVESTON BAY COASTAL CHANGE GRADE

Coastal change is emerging as a high priority as communities around the world face climate-related challenges. Nearly half of the U.S. population lives in coastal areas and the majority live in urban centers such as the Houston-Galveston metropolitan area. It is vital that we understand our vulnerabilities to a changing coast and adapt to enhance resilience in the Houston-Galveston region and along Texas' coastline. Vulnerabilities for a coastal metropolis often involve our reliance on and proximity to water.

Making the Grade

Water temperature and pH in Galveston Bay have leveled out over the years, but the drought of 2010-2011 had some significant effects on the ecosystem. Currently, temperature and pH remain steady. But the high rate of relative sea level rise occurring in Galveston, and the increasing demands for freshwater due to our expanding population, cannot be ignored by the more than six million people living in Galveston Bay's lower watershed. The combination of subsidence and sea level rise is also responsible for the loss of thousands of acres of wetland habitat over the last 100 years, further exposing the region to increased flooding from storm surge.

WHAT YOU CAN DO

Keep Galveston Bay Clean

OBSERVE SEAFOOD ADVISORIES

- Landscaping with native plants and leaving grass clippings on your yard can help you reduce your outdoor watering.
- On average, the Houston-Galveston area receives more than 50 inches of rain per year, so monitor the weather and only water to supplement rainfall.
- Installing water-saving appliances, like low-flow showerheads and kitchen faucet aerators, can add up to significant savings both in your wallet and for the river or aquifer supplying your city with water.
- Visit the Texas Water Conservation Score Card to see what municipal water suppliers in your city are doing to save water and to sign a petition urging them to prioritize water conservation programs in your community.
- Learn to conserve water at your home or business.
- Join the Galveston Bay Water Brigade. Enter your pledge to conserve water at home and/or work and become a Water Brigade Member!

LOWER YOUR CARBON FOOTPRINT

- Reduce vehicle emissions, lessen electricity usage, and recycle whenever possible.
- Carpool to work or school and make fuel efficiency a priority when purchasing your next vehicle.

USE LESS "STUFF"

- The process of creating, transporting, and throwing away "stuff" uses an immense amount of energy at every step.
- Reduce the amount of material you buy and consume, reuse and repurpose items whenever possible, and recycle materials rather than sending them to landfills.
- Watch The Story of Stuff.

BE A CITIZEN SCIENTIST

- Learn how to properly observe signs of coastal change by observing the world around you and reporting what you find.
- For interest in plants and animals, check out these resources for citizen science programs.
- For interest in water quality, learn about the Galveston Bay Foundation's Water Monitoring Team or become a part of the Texas Stream Team program.

FRESHWATER INFLOWS

- The Bay's health depends on freshwater flowing from the rivers, bayous, and creeks.
- The amount and timing of freshwater inflows are directly related to salinity, available nutrients, and stabilizing sediment.
- The Bay's freshwater inflows are maintaining, but increasing water use and climate variability threaten their future reliability.

Bays and estuaries are bodies of water where freshwater and marine environments mix. The Galveston Bay ecosystem depends upon an adequate amount of freshwater flowing to it from the Trinity and San Jacinto Rivers, as well as area bayous and creeks. The term "environmental flow" refers to water flowing in rivers, streams, lakes, and reservoirs, and includes freshwater inflows to bays and estuaries, as well as to flows in inland stream systems.

Freshwater inflows are influenced by precipitation (mainly rain) and water use by a growing human population. Runoff and wastewater effluent from treatment plants make up a significant percentage of the freshwater flowing into Galveston Bay. It is hard to say exactly how much freshwater Galveston Bay needs, however. But we do know that the amount and timing of freshwater flowing into the Bay are directly related to salinity, the availability of nutrients to fuel the food web, and the availability of sediment that supports Bay habitats.

Galveston Bay Freshwater Inflows Grade: C (Maintaining)

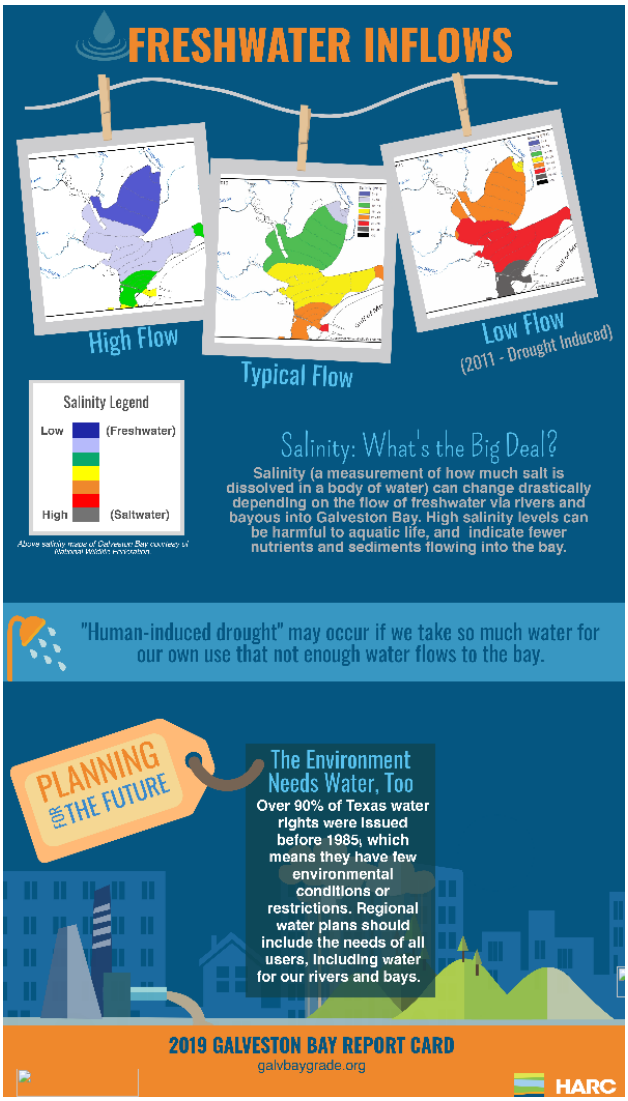
Photo by Anja Borski

Galveston Bay received a C for freshwater Inflows based on 2017 data. The 2018 data have not been released yet. On average, the Houston-Galveston region receives 40-50 inches of rainfall a year. However, the region experienced an extreme drought between 2010 and 2012, with extremely dry conditions in 2011. In 2015, 2016, and 2017 rainfall rates were again above average with major flood events in all three years. With the end of the drought and three sequential years of higher than average rainfall, the Bay's rivers, bayous and creeks appear to be maintaining an adequate rate of flow for now, yielding a C. However, increasing water use and climate variability threatens the future availability of freshwater inflows in the region.

We need to consider changes now to ensure that freshwater will continue to flow to Galveston Bay. These adjustments should range from cutting daily water use, to better regulation of water resources by the state. Even flood events like those in May 2015, April 2016 and Hurricane Harvey sometimes do not reduce long-term drinking water scarcity or alter long-term conditions in the Bay.

Freshwater inflows from rivers and bayous were drastically reduced during the drought of 2011-2012, providing insight into what Galveston Bay would look like if starved of freshwater. The occasional heavy rainstorm might not have a noticeable impact on the salinity of the Bay, but the prolonged drought did.

FRESHWATER INFLOWS



See the Data

The Texas Water Development Board (TWDB) produces freshwater inflow models that take into account the balance of inflows from rivers and runoff from land, return flow of wastewater effluent from treatment plants, water diversion, and rain and evaporation.

Grading scale

The freshwater inflows grade in the Galveston Bay Report Card is based on trend analysis of TWDB's model of freshwater entering the Bay, and 2017 inflow data compared to a baseline established by the average freshwater balance, modeled by the TWDB from 2003-2016.

WHAT YOU CAN DO

Conserve Our Freshwater Inflows

- Pledge to save water and save Galveston Bay.
- Learn how much water can be saved by making small changes in our landscaping routines.
- Speak up for the Bay by participating in state and regional water planning processes.

Conserving water resources is the easiest and least expensive way to ensure that freshwater continues to flow to Galveston Bay. Making small changes in our landscaping routines can save a significant amount of water.

You can speak up for the Bay by participating in state and regional water planning processes. Region H covers a 15-county area that includes the city of Houston and much of the lower Galveston Bay watershed. Decisions made by Region H determine how we allocate water resources for recognized water use categories. Currently, the environment is not included as a recognized water use, which means there are no additional environmental flow protections. Stay informed about public meetings and opportunities to let your voice be heard.

SEA LEVEL

- Relative sea level rise is the combination of subsidence (the sinking of land due to groundwater withdrawal) and rising ocean levels.
- Sea level rise affects vital coastal habitats, as well as human communities.
- Galveston Bay's long history of sea level rise, subsidence, storm surge, and flooding makes sea level an issue of critical concern.

As oceans warm up, the water expands and sea levels rise. Melting glaciers and ice caps are also adding water to our oceans. Relative sea level rise is the combination of subsidence and rising ocean water levels.

Galveston Bay Sea Level
Grade: F (Critical)

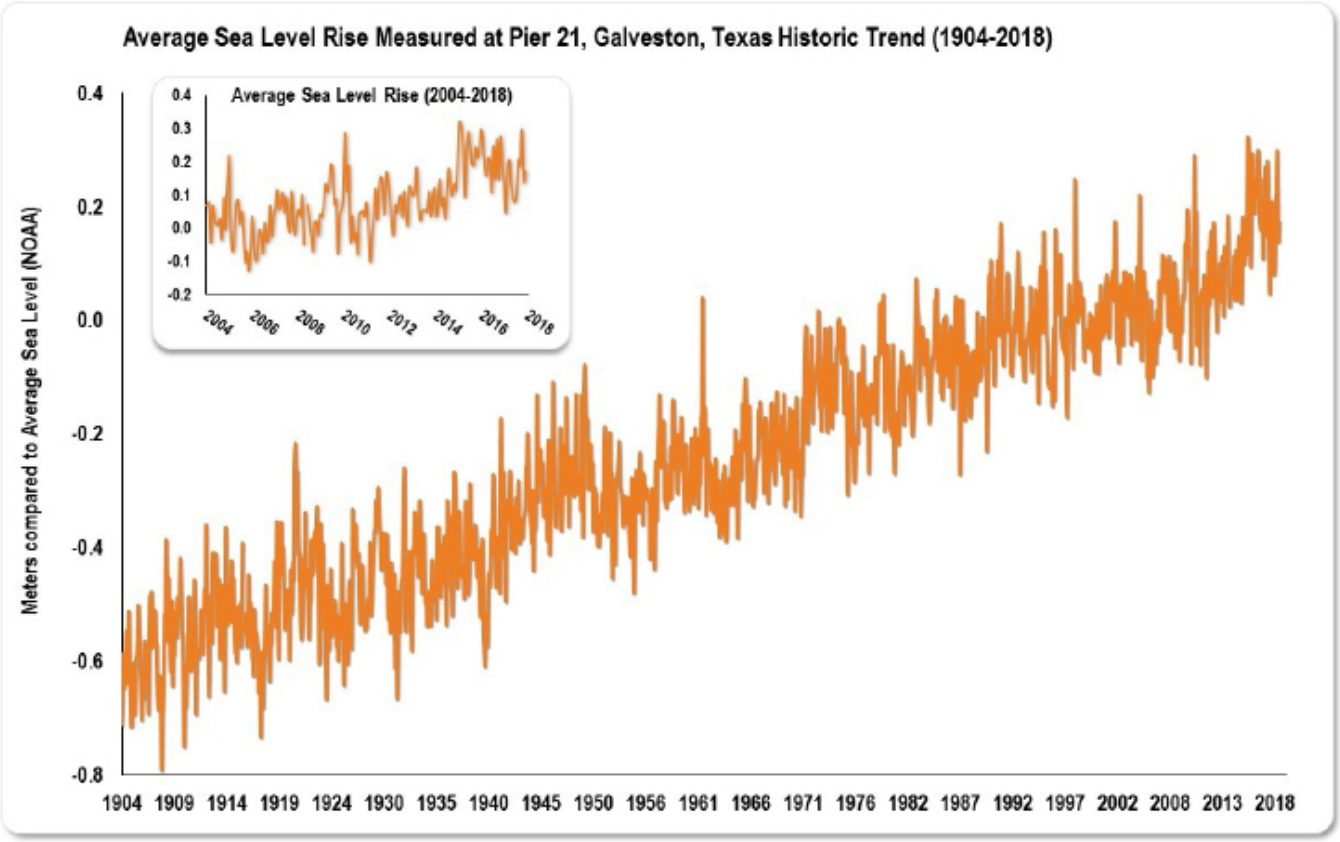
The Galveston Bay region has a long history of sea level rise, subsidence, storm surges, and flooding. As sea level rise continues, periodic flooding from storm surges and rain events is likely to get worse. Coastal cities around the U.S. such as Miami Beach, Florida; Wilmington, Delaware and Annapolis, Maryland are already dealing with chronic coastal flooding and finding ways to adapt to become more resilient. Floods can be very dangerous, and the resulting damage is extremely expensive. Human communities are not the only ones at risk from sea level rise.

Photo by Galveston Bay Foundation

Wetlands exist at the water's edge, and they naturally migrate inland as sea level rises. But in most areas of Galveston Bay, there is no place for them to go. As a result, they become permanently flooded and the vegetation dies, effectively destroying the wetlands. Planning for sea level rise should include changes to human communities and infrastructure. But it should also take into account where vital coastal habitats like wetlands, seagrass beds, mud flats, and sand dunes exist when water levels rise.

SEA LEVEL

See the Data



The National Oceanic and Atmospheric Administration (NOAA) measures the sea level from Pier 21 on the bay side of Galveston Island. Over the last 100 years, sea level at Pier 21 has risen more than two feet. At 6.62 mm/year, Galveston has one of the highest- measured rates of sea level rise in the country.

Grading scale

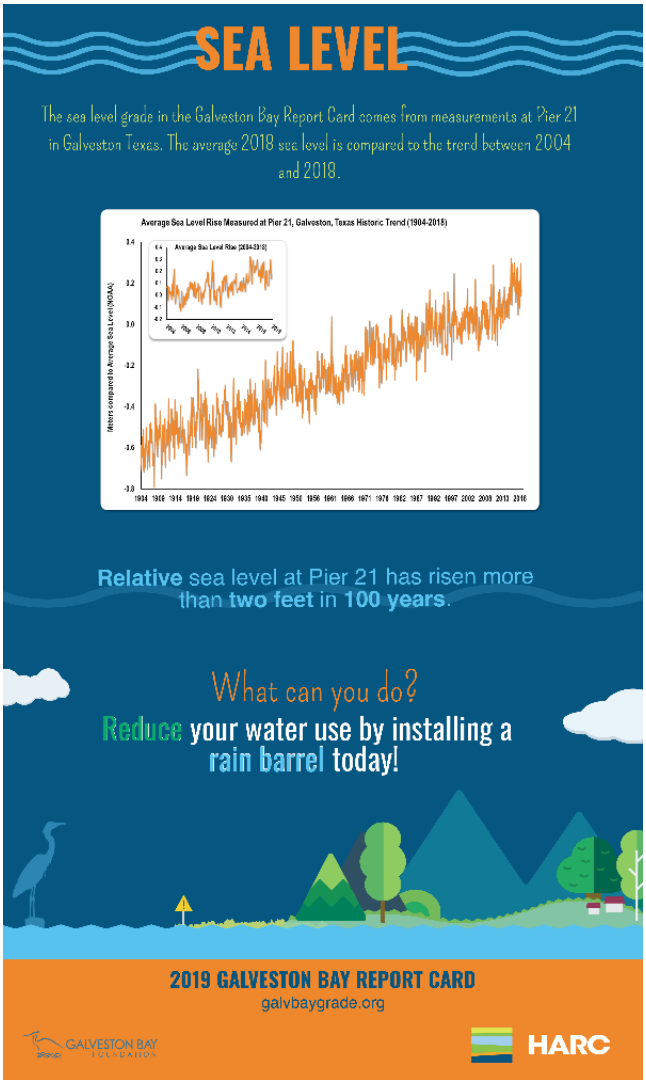
The sea level grade in the Galveston Bay Report Card is based on trend analysis of sea level rise data from Galveston Pier 21, and 2018 data compared to a baseline established by the average sea level measured at Galveston Pier 21 from 2004-2017.

WHAT YOU CAN DO

Become More Resilient to Rising Sea Level

- Contact your local officials and ask how your community is becoming more resilient and preparing for a changing coast.
- Protect and restore habitat like wetlands and seagrass.
- Reduce your influence on the extent and rate at which coastal change takes place by reducing your carbon footprint.

SEA LEVEL



Sunny day flooding — which is when low-lying areas are inundated with seawater during high tides not associated with storms — is a real threat facing coastal communities around the world. In parts of Florida, sea level rise is already prompting major infrastructure investments to cope with routine flooding now occurring on sunny days.

Municipalities like Miami Beach are looking at spending as much as $400 million on pumping systems. Saltwater encroachment in Hallandale Beach, Florida, has forced officials to abandon six of their eight drinking-water wells. According to the National Climate Assessment, nearly five million people in the United States live within four feet of the local high-tide level. Learn more at www.globalchange.gov.

Carbon dioxide, black carbon (fine particulate matter or soot), and methane are identified as the primary contributors to climate change. Pollution reduction is one of our greatest weapons against coastal change like sea level rise, and reducing pollution means consuming less energy. Make an effort to drive less, unplug devices when they are not in use, turn off unnecessary lights, and try to find local sources of foodand merchandise.

WATER TEMPERATURE

- Winter water temperatures represent the lowest temperatures that plants and animals endure in order to live in the Bay.
- As changes in climate impact water temperatures, species of plants and animals move into new areas where they were not previously found.
- Winter water temperatures in Galveston Bay (from December to February) from 2004 to 2018 did not exhibit an increase.

Winter water temperature represents the lower range of temperatures that plant and animal species have to endure to be able to live in Galveston Bay. The lowest extreme is important when considering southern fish, plant, and animal species that might be moving northward along the Gulf Coast. If new species can expand into Galveston Bay due to warming water, they may be able to outcompete native species and shift the balance of the Galveston Bay ecosystem.


Photo by Ashley Borski

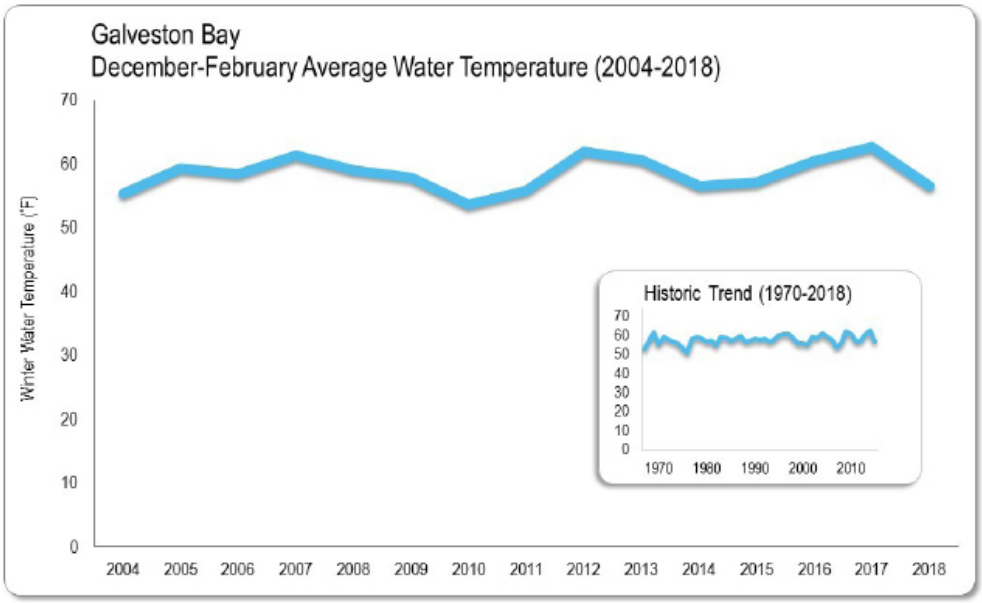
Galveston Bay Water Temperature Grade: A (Excellent)

There has not been a significant change in winter water temperatures for the months of December through February between the years 2004 and 2018, indicating that Galveston Bay may currently be limited to range expansion of southern species. Warming trends have been observed in bays south of Galveston Bay,* so ongoing monitoring will continue to be an important component of assessing the impact of coastal change on the Galveston Bay system.

Tolan, J. M., & Fisher, M. (2009). "Biological response to changes in climate patterns: population increases of gray snapper (Lutjanus griseus) in Texas bays and estuaries." Fishery Bulletin, 107(1), 36-43.

WATER TEMPERATURE

See the Data



The TCEQ and Texas Parks and Wildlife Department Coastal Fisheries Division collect water temperature data through their regular monitoring programs.

Grading scale

The water temperature grade in the Galveston Bay Report Card is based both on our best professional judgment of trend analysis of water temperature data, and on 2018 surface water temperature data for December, January, and February, compared to a baseline established by the average winter water temperatures from 2004-2017.

WHAT YOU CAN DO

Keep an Eye Out for Birds

- Educate yourself on invasive species (species of plants, animals, and microorganisms that are not native to the region) using the Galveston Bay Area field guides.
- Learn about how changing temperatures affect coastal environments. Water temperature affects the amount of dissolved oxygen in the water and also tells us what types of plants and animals are able to live in the estuary.
- Report aquatic invasive species to the Texas Parks and Wildlife Department 1-800-792-4263.

Appearance of new species in Galveston Bay is not always a cause for concern, but some species are invasive and should be reported.

WATER PH

- Water acidity or alkalinity is measured by pH values. The lower the pH, the higher the acidity.
- Acidification of estuaries like Galveston Bay reduces the ability of shellfish (such as oysters) and some microscopic phytoplankton to produce and maintain their protective shells.
- pH values in the Bay are excellent, maintaining, and in a safe range for aquatic life.

When we want to know how acidic a sample of water is, we measure the association of water molecules and their ions, called pH. Through a chemical reaction, carbon dioxide from the atmosphere dissolves in the ocean, raising the acidity (low pH) of the water. The burning of fossil fuels increases the amount of carbon dioxide in the atmosphere and, thus, in our oceans. Acidification of oceans and estuaries is reported by scientists around the world.

Photo by Chris Kuhlman

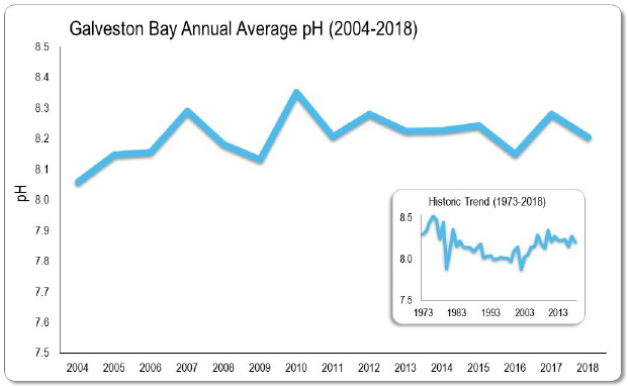
Since Galveston Bay's pH is determined by the mixture of saltwater from the Gulf of Mexico and freshwater from the rivers and bayous in the watershed, changes in either source can have an impact. Acidity or alkalinity in estuarine waters is especially of concern for fish and calcium-carbonate-forming organisms like oysters and some phytoplankton.

Galveston Bay Water Temperature Grade: A (Excellent)

Galveston Bay receives an A for maintaining the pH values that have returned to typical values after a decline during the drought of 2010-2011. There has not been a significant change in the pH of Galveston Bay waters between 2004 and 2018. Currently, pH values are not in a range that is harmful to fish, oyster larvae, or shell formation.

WATER PH

See the Data



The Texas Commission on Environmental Quality (TCEQ) monitors water pH around Galveston Bay. Samples were collected near the water's surface, at less than 0.5 meter depth.

Grading scale

The pH grade in the Galveston Bay Report Card is based both on our best professional judgment of trend analysis of pH data, and on 2018 surface water pH compared to a baseline established by the average pH from 2004-2017.

WHAT YOU CAN DO

Reduce Your Carbon Footprint

- Pollution in the air, soil, or directly in the water, can all affect pH. Take steps to reduce pollution in your daily activities, and report industrial pollution to authorities.
- Learn about the science behind ocean acidification.
- Join the Oyster Shell Recycling Program, which helps the Bay naturally reduce acidity.

It's important to note that a seemingly small decrease of 0.1 in pH units actually indicates a 30 percent increase in acidity.

Seawater is naturally alkaline (it has a high pH, typically between 7.5 and 8.4) because of the presence of carbonate ions (CO). Because of this alkalinity, seawater has a buffering capacity and can absorb large amounts of CO. Prior to the drought of 2010-2011, data describing pH trends in Galveston Bay showed rising acidity. The one benefit of the drought is that the declining pH trend has disappeared for now.

Acidification of estuaries reduces the ability of shellfish (such as oysters) to produce and maintain their protective shells, having a negative impact on this habitat type. Efforts to return oyster shells to the Bay after harvest help to increase this habitat. The same is true of efforts to increase populations of oysters in the Bay, like the Galveston Bay Foundation's Oyster Shell Recycling Program.