
# Safe for Swimming 2022 Texas Edition

## Pollution at our beaches and how to prevent it

ENVIRONMENT TEXAS
RESEARCH & POLICY CENTER

# Safe for Swimming 2022 Texas Edition

**Pollution at our beaches**

**and how to prevent it**

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# Contents

# *Executive Summary*

The Clean Water Act, adopted in 1972 with overwhelming bi-partisan support, had the farsighted and righteous goal of making all our waterways safe for swimming. Half a century later, all too often, Texans visiting their favorite beach are met by an advisory warning that the water is unsafe for swimming. Even worse, according to the Center for Disease Control (CDC), about 7.2 millions of Americans have been sickened by swimming in contaminated water every year.[1]

In Texas, an analysis of bacteria sampling data from beaches in 9 coastal counties consisting of 104 beach sites virtually all sites tested were potentially unsafe for swimming at some point in 2021. Only 12 sites did not have at least one potentially unsafe day, and 26 sites were potentially unsafe at least 25 percent of the days that sampling took place. Additionally, a year over year analysis shows a clear increasing trend in both the average number of days a beach is under an advisory action and the average number of days a beach is under an action due to *Enterococcus*.

Sites were considered potentially unsafe if bacteria levels exceeded the U.S. Environmental Protection Agency's (EPA's) most protective "Beach Action Value" (BAV) thresholds, which the EPA suggests states use as a "conservative, precautionary tool for making beach notification decisions," and are associated with an estimated illness rate of 32 per 1,000 swimmers.[2] When examining contamination via *enterococcus*, the main indicator in this analysis, the BAV recommended by the EPA is 60 colony-forming units per 100 milliliters (cfu/100mL), for both marine and freshwater. The Texas General Land Office (GLO), which runs the Texas Beach Watch program, uses a different standard of beach monitoring levels; Low <35 cfu, Medium 36-104 cfu, and High >104 cfu. (See Methodology for details.)

While an effort to mitigate bacterial contamination is underway by multiple levels of state government and community organizations, it is clear that much work remains to be done. To protect our health at the beach, our state policymakers and regulatory agencies must enact sound decisions to prevent fecal pollution, including deploying natural and green infrastructure to absorb stormwater.

## *Fecal contamination makes beaches unsafe for swimming*

Our beaches are at risk. Human contact with water contaminated by fecal bacteria can result in gastrointestinal illness, respiratory disease, ear and eye infections, and skin rash.[3] Each year in the U.S., swimmers suffer from an estimated 57 million cases of recreational waterborne illness.[4] The main

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[1] Center for Disease Control, *Waterborne Disease in the United States,* 01 Dec 2020, https://www.cdc.gov/healthywater/surveillance/burden/index.html

[2] Environmental Protection Agency, *Detection and Quantification Limits of EPA Enterococcus qPCR Methods*, EPA 820-R-13-013, Dec 2013, https://www.epa.gov/sites/default/files/2015-09/documents/detection-quantitation-limits_epa-enterococcus-qpcr-methods_dec-2013.pdf

[3] U.S. Environmental Protection Agency, National Beach Guidance and Required Performance Criteria for Grants, 2014 Edition, 31 July 2014, archived at https://web.archive.org/web/20180706154821/https://nepis.epa.gov/Exe/ZyPDF.cgi/P100KZDK.PDF?Dockey=P100KZDK.PDF.

[4] Stephanie DeFlorio-Barker et al., "Estimate of incidence and cost of recreational waterborne illness on United States surface waters," Environ Health, 9 January 2018, doi: 10.1186/s12940-017-0347-9.

sources of fecal contamination are urban runoff caused by unchecked development, sewage leaks and overflows from private and public systems, and manure runoff industrial-scale livestock operations. These sources of contamination threaten the waters where Texans swim. As more extreme weather events brought on by climate change bring heavy flows of stormwater each of these factors are exacerbated.

- Sprawling development has created more impervious surfaces that cause runoff pollution and has destroyed natural areas like wetlands that protect beaches from contamination.
- Texas' sewage infrastructure is deteriorating and outdated. Many communities still use combined sewers that were designed to discharge sewage directly to waterways during heavy rainfall. Sanitary sewers, which are designed to carry sewage alone, can also spill dangerous sewage if they are not properly maintained, and overflow as many as 75,000 times each year in the U.S.[5]
- The rise of factory farms has resulted in large concentrations of livestock manure that cannot be stored safely and is often overapplied to crops. During rainfall, excess manure from cropland enters our waterways where it can put swimmers' health at risk. Animal manure can also contain pathogens that are resistant to antibiotics, creating added risk to public health.[6]

*To keep our beaches safe for swimming and protect our citizen's health, policymakers should undertake efforts to prevent runoff pollution, including the use of natural and green infrastructure that absorbs stormwater onsite. These include:*

- Dramatically increasing funding to fix sewage systems and prevent runoff pollution by incentivizing natural and green infrastructure, including rain gardens, living shorelines, permeable pavement, and green roofs.
- Protecting inland resources such as wetlands that filter out pollutants and bacteria, and streams, which discharge to coastal areas where people swim.
- Enacting moratoriums on new or expanded industrial-scale livestock operations, particularly in areas that threaten our beaches and other waterways.

Policymakers should also ensure that swimmers are presented with the best-possible information to make decisions regarding their health. Officials should expand funding for beach testing, to ensure adequate testing at all beaches. Texas should adopt EPA's more protective BAV bacteria standard for making beach advisory decisions and should work to implement same-day bacteria testing and warning systems prioritizing high use areas.

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[5] U.S. Environmental Protection Agency, *Sanitary Sewer Overflows (SSOs)*, archived on 4 June 2019 at http://web.archive.org/web/20190604222204/https://www.epa.gov/npdes/sanitary-sewer-overflows-ssos.
[6] Amy Sapkota et al., "Antibiotic-resistant enterococci and fecal indicators in surface water and groundwater impacted by a concentrated swine feeding operation," *Environmental Health Perspectives*, July 2007, doi: 10.1289/ehp.9770.

## *Introduction*

We Texans love our beaches. Whether swimming in the warm waters of South Padre Island, pulling Bull Redfish out of Sabine Pass, or dolphin spotting in Galveston, Texas' beaches enrich the lives of millions of citizens and tourists, providing them a place to escape the city, soak up the sun, and cool off in the hot summer months.

Texans should be able to expect that water at our beaches is clean and safe for swimming. In fact, that was a key goal when our nation adopted the Clean Water Act in 1972. But all too often, those looking for a summer getaway arrive at the beach only to be met by an advisory sign warning of unsafe water. Even worse, millions of Americans in recent years have been sickened by swimming in contaminated water, with many hospitalized.

As the following analysis shows, far too many beaches along the Texas Gulf Coast can be unsafe for swimming.

The causes are often manmade and therefore controllable. Reckless development destroys wetlands that filter pollutants; outdated sewer systems send raw waste directly into waterways; and agricultural practices create an excess of manure, which may contain pathogens resistant to antibiotics, that finds its way into our waterways.

In different areas of the state there are different culprits for beach pollution, including many types of urban and agricultural runoff pollution. But all areas can implement solutions to prevent pollution from being created in the first place, or to keep pollution from reaching the waters where our families go to swim. These solutions can come from every municipal level whether it be at the state, county, or city level. Making those changes can protect public health and the environment, and help ensure that families across Texas can continue to look to the beach as a summer haven, now and in the future.

### *Fecal Contamination of Swimming Areas Poses a Public Health Threat*

People who swim in water polluted with sewage or other fecal contamination risk falling seriously ill. Human contact with fecal contamination can result in gastrointestinal illness as well as respiratory disease, ear and eye infections and skin rash.[7] Although for testing purposes fecal contamination is typically indicated by the presence of bacteria (including the E. coli and enterococcus bacteria samples in the following analysis), most illnesses contracted from swimming in contaminated water are transmitted by viruses contained in fecal matter.[8] Norovirus is likely the most common cause of viral recreational water outbreaks, and can cause diarrhea, vomiting, nausea, and stomach pain.[9]

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[7] U.S. Environmental Protection Agency, *National Beach Guidance and Required Performance Criteria for Grants, 2014 Edition*, 31 July 2014, archived at https://web.archive.org/web/20180706154821/https://nepis.epa.gov/Exe/ZyPDF.cgi/P100KZDK.PDF?Dockey=P100KZDK.PDF.

[8] U.S. Environmental Protection Agency, *2012 Recreational Water Quality Criteria*, 2012, archived at http://web.archive.org/web/20190502174719/https://www.epa.gov/sites/production/files/2015-10/documents/rwqc2012.pdf.

[9] R.G. Sinclair et al., "Viruses in recreational water-borne disease outbreaks: a review," *J Appl Microbiol*, 107(6), December 2009, doi: 10.1111/j.1365-2672.2009.04367.x.

Each year in the U.S., swimmers in oceans, lakes, rivers and ponds suffer from an estimated 57 million cases of recreational waterborne illness.[10] From 2000 to 2014, 140 outbreaks caused by recreational water contamination reported to the Centers for Disease Control and Prevention (CDC) caused 4,958 illnesses and two deaths.[11] In a single 2013 incident listed on the CDC's website, 597 people fell ill and three people were hospitalized with gastrointestinal illness from a contaminated Michigan lake (the lake was not named by the CDC).[12] Consuming oysters and other seafood harvested from contaminated water can also pose a health threat.[13]

Water contamination can also ruin a day at the beach, when it results in beach closures or swimming advisories. In 2018, there were 871 beach closings resulting from elevated bacteria or sewage in the U.S., and 4,824 beach contamination advisories warning people not to go in the water.[14] There were an additional 5,295 swimming advisories that water contamination was likely because of rainfall.[15] While beach advisories are a critical tool to protect swimmers, many testing programs rely on a testing process that requires nearly 24 hours to show results, meaning that swimmers have already been exposed to unsafe water by the time advisories are posted.[16]

## *Runaway development, aging infrastructure, and large farm operations are the main threats*

Although some beach contamination results from natural sources such as wildlife, many of the most dangerous risks posed to swimmers are the result of human activity. In recent decades, three trends in particular – the developing and paving of natural areas in coastal regions, the deterioration of sewer systems, and the rise of factory farms – have resulted in harm to our beaches. Climate change, which brings more wet weather and flooding, is exacerbating this harm. Without action to reverse these trends, more beach closures and water pollution are likely in years to come.

### *Runaway development:*

When rain runoff flows over yards, parks and other urban and suburban areas, it can pick up fecal waste from pets and wildlife. Runoff flows into streams, lakes and the ocean, either directly or indirectly through storm drains. The U.S. EPA's BEach Advisory and Closing Online Notification (BEACON) system shows that advisories and closures on Texas beaches are almost four times as likely to be caused by runoff as any other cause.[17]

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[10] See note 4.
[11] Centers for Disease Control and Prevention, "Outbreaks associated with untreated recreational water — United States, 2000–2014," *Morbidity and Mortality Weekly Report 2018*, 29 June 2018, doi: 10.15585/mmwr.mm6725a1.
[12] See note 11.
[13] See note 11.
[14] U.S. Environmental Protection Agency, *BEACON - Beach Advisory and Closing On-line Notification - Beach Actions (Advisories and Closures)*, data for 2018 downloaded on 31 May 2019 from https://watersgeo.epa.gov/beacon2/.
[15] Leslie Nemo, "How Chicago Got a Lot Faster at Beach Water Warnings," *CityLab*, 14 June 2019, available at https://www.citylab.com/environment/2019/06/safe-beaches-swim-chicago-lake-water-quality-test-alert/591727/.
[16] See note 15.
[17] U.S. Environmental Protection Agency, *BEACON - Beach Advisory and Closing On-line Notification - Beach Actions (Advisories and Closures)*, data for 2018 downloaded on 07 June 2022 from https://watersgeo.epa.gov/beacon2/.

From 1996 to 2016, the land cover in Texas coastal counties has changed between 4.43% in Aransas County and 17.47% in Harris County.[18] A study by NOAA looking at changes between 1996 and 2010 shows that the gulf coast has had a net of 996 square miles of wetlands and 8,706 square miles of forest cover. At the same time, we added more than 1,536 square miles of development or one football field every 10 minutes.[19]

Heavy development of coastal zones, and the resulting loss of natural areas, is exacerbating the problem of runoff pollution. This development both creates new sources of runoff fecal pollution and also makes it easier for that pollution to reach the water by replacing natural vegetated areas with impervious surfaces.

Natural features like wetlands – often known as marshes, bogs and swamps – play an important function in protecting water quality. Wetlands can absorb runoff and remove harmful pollutants, including fecal contamination, preventing the contamination of coastal waters and other waterways.[20]

Impervious surfaces including roads and parking lots increase the quantity of runoff pollution that reaches waterways and beaches, because water flows over impervious surfaces, rather than absorbing into the ground.

Research links increased amounts of impervious surface in an area with negative water quality impacts, including higher levels of fecal indicator bacteria. A 2014 study from the journal Hydrological Processes noted that an "increase in impervious surfaces will intensify current undesired impacts of development by converting even more rainfall to stormwater runoff" and that "[c]oncentrations of indicators of water quality degradation (e.g., chemicals, nutrients, bacteria, viruses) increase in waterways as development increases."[21] Climate change is further exacerbating the problem of runoff pollution, as flooding and heavy rainfall events become more frequent. The aforementioned study noted that "[i]ncreased rainfall from heavy storm events will amplify the negative impacts of runoff that are already intensified by increasing development."[22] A separate study modeled climate and development impacts in one county in South Carolina and found that runoff quantity could triple under severe climate change scenarios.[23]

### *Sewage overflows and failing septic systems:*

When sewage systems leak or overflow, human fecal waste spills into the environment and can contaminate waterways.[24] Sewage contamination is particularly dangerous for public health because it

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[18] National Oceanic and Atmospheric Administration, *Coastal Change Analysis Program Atlas,* 19 June 2022, https://coast.noaa.gov/ccapatlas/

[19] U.S. Environmental Protection Agency, *Gulf of Mexico Regional Land Cover Change Report 1996–2010,* 2011, retrieved from: https://coast.noaa.gov/data/digitalcoast/pdf/landcover-report-gulf-coast.pdf

[20] A.D. Karathanasis et al., "Vegetation effects on fecal bacteria, BOD, and suspended solid removal in constructed wetlands treating domestic wastewater," *Ecological Engineering*, May 2003, doi: 10.1016/S0925-8574(03)00011-9.

[21] Anne Blair et al., "Exploring impacts of development and climate change on stormwater runoff," *Hydrological Processes*, 2014, doi: 10.1002/hyp.9840.

[22] See note 21.

[23] Anne Blair and Denise Sanger, "Climate change and watershed hydrology—heavier precipitation influence on stormwater runoff," *Geosciences*, July 2016, doi: 10.3390/geosciences6030034.

[24] U.S. Environmental Protection Agency, *Report to Congress on Impacts and Control of Combined Sewer Overflows and Sanitary Sewer Overflows*, August 2004, archived at

contains human waste, which contains bacteria, viruses and parasites more likely to cause disease in humans.[25]

As with runoff, the threat of sewage spills is exacerbated by the loss of green space and the development of natural areas, as the same stormwater that can directly impact waterways can also overwhelm sewer systems. As a New York Times analysis described:[26]

> *As cities have grown rapidly across the nation, many have neglected infrastructure projects and paved over green spaces that once absorbed rainwater. That has contributed to sewage backups into more than 400,000 basements and spills into thousands of streets, according to data collected by state and federal officials. Sometimes, waste has overflowed just upstream from drinking water intake points or near public beaches.*

Meanwhile, sewage is often handled by deteriorating, poorly maintained, or outdated sewer systems. The EPA writes that much of our network of sewage infrastructure was built right after World War II and that "investment has not been enough to meet the ongoing need to maintain and renew these systems."[27]

All types of sewer systems can be a source of water contamination, including combined sewers, sanitary sewers, and septic systems. Combined sewer systems are designed to discharge excess waste directly to nearby waterways during heavy rain events.[28] Sanitary sewers, which are designed to carry sewage alone, are less prone to overflows than combined sewers, yet can also spill dangerous sewage if they are overwhelmed or poorly maintained.[29]

Corpus Christi in Nueces County, which has seven of the ten most contaminated beaches in this report, has ongoing significant infrastructure issues. Some sewer lines are almost a century old, and the EPA found 450 miles of city sewage pipes likely to clog or crack.[30] After 15 years of litigation, Houston finalized a $2 billion consent decree to curb sewage discharges into local waterways caused by broken pipe and storm overflows.[31]

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http://web.archive.org/web/20170525051046/https://www.epa.gov/sites/production/files/2015-10/documents/csossortc2004_full.pdf.

[25] Woods Hole Oceanographic Institution, *Beach Closures*, archived on 12 April 2019 at http://web.archive.org/web/20190412165744/https://www.whoi.edu/know-your-ocean/ocean-topics/pollution/beach-closures/.

[26] Charles Duhigg, "*As sewers fill, waste poisons waterways*," The New York Times, 22 November 2009.

[27] U.S. Environmental Protection Agency, *Building Sustainable Water Infrastructure*, archived on 4 June 2020 at http://web.archive.org/web/20200604082015/https://www.epa.gov/sustainable-water-infrastructure/building-sustainable-water-infrastructure.

[28] See note 23.

[29] See note 24.

[30] Pappalardo, Joe, Texas Monthly, *Corpus Christi's Crappy Sewage System Begins Its Cleanup*, 24 March 2022, https://www.texasmonthly.com/news-politics/corpus-christi-wastewater-sewer-repairs/

[31] Walton, Brett, Circle of Blue, Houston Agrees to $2 Billion Sewer Fix, 06 September 2019, https://www.circleofblue.org/2019/world/houston-agrees-to-2-billion-sewer-fix/

Yet experts note that the problem goes beyond old sewage infrastructure: The root causes are statewide development trends and rapidly diminishing green space, which have increased stormwater runoff and overwhelmed sewage systems across the state.[32]

Deteriorating sewers can experience exfiltration (sewage leaking from pipes) or infiltration (groundwater or stormwater entering pipes, which can then cause overflows).[33] Storm events and high water levels can also overwhelm sewage treatment plants themselves, which can be located near coasts and waterways.[34]

Private septic systems, which are used in approximately 20% of new Texas homes[35] are also a major source of sewage pollution that affects beaches and coastal areas.37 Failure rates and efficacy of septic systems are dependent on many factors such as age and placement, but generally, almost 50% of all septic tank systems do not function properly.[36] Septic system maintenance typically depends on homeowners, and research has found that many septic system owners may not understand how often maintenance is required, or the importance of maintenance for the environment and public health.[37] Septic systems are often used in areas with sprawling development, where building centralized sewer and water treatment systems is difficult or prohibitively expensive.[38]

Combined sewers are particularly prone to high-volume releases of dangerous pollution because the combination of stormwater and sewage into a single pipe can overwhelm the system following heavy rainfall or snowmelt.[39] In 2004, the EPA estimated that 850 billion gallons of untreated wastewater and stormwater are released as a result of combined sewer overflows each year.[40]

Sanitary sewers overflow as many as 75,000 times each year in the U.S.[41] Sanitary sewer overflows have causes including inadequate capacity, system deterioration, blockages and line breaks. As previously

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[32] Russ Zimmer, "*Human waste has been leaking from Belmar's sewers into the Shark River*," Asbury Park Press, 11 April 2019, available at https://www.app.com/story/news/local/land-environment/2019/04/11/belmar-nj-shark-river-water-pollution-sewage/3350392002/

[33] Exfiltration: Robert Amick and Edward Burgess, U.S. Environmental Protection Agency, *Exfiltration in Sewer Systems*, March 2003, available at https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100E5PY.txt;

[34] Matt Kiernan, "*This stinks! Spill dumps record-setting 25 million gallons into Stamford Harbor,*" The Hour, 1 May 2014, available at https://www.thehour.com/stamford/article/This-Stinks-Spill-dumps-record-setting-25-8095473.php.

[35] Texas Commission on Environmental Quality, *Basics for Septic Systems*, Last modified 06 May 2022, https://www.tceq.texas.gov/assistance/water/fyiossfs.html

[36] Water and Wastewater Equipment Manufacturers Association, *Eliminating Failing Septic Tanks in the United States Final Position Statement*, 06 May 2020, https://wwema.org/wp-content/uploads/2020/09/PositionPaperFailingSepticSystems050320.pdf

[37] Natalie Johnson, University of Illinois at Urbana-Champaign, *Homeowners' Knowledge & Awareness of Septic Systems and Barriers to Septic System Maintenance in Northwest Indiana: Information to Enhance Agency Outreach and Education Efforts*, 28 April 2016, available at http://hdl.handle.net/2142/90643.

[38] Chesapeake Bay Foundation, *Sprawl*, archived on 23 August 2019 at http://web.archive.org/web/20190823223741/https://www.cbf.org/issues/land-use/the-impact-of-sprawl.html.

[39] U.S. Environmental Protection Agency, *Impacts and Control of CSOs and SSOs*, August 2004, EPA 833-R-04-001

[40] See note 39.

[41] U.S. Environmental Protection Agency, *Sanitary Sewer Overflows (SSOs)*, 10 July 2021, https://www.epa.gov/npdes/sanitary-sewer-overflows-ssos

mentioned, eteriorating sewers can experience exfiltration (sewage leaking from pipes) or infiltration (groundwater or stormwater entering pipes, which can cause backups and overflows).[42]

*Livestock manure:*

According to the National Association of Local Boards of Health, fecal pollution from agriculture is "responsible for many beach closures and shellfish restrictions."[43] This pollution risk is markedly worse at factory farms (also known as "concentrated animal feeding operations" or CAFOs), because of the sheer volume of manure generated.

In recent decades, meat and dairy production in America has radically shifted from small farms to industrial-scale operations.[44] In 1992, for example, less than one third of all hogs were raised on farms with more than 2,000 animals; in 2012 that increased to 97% of hogs.[45] As of the end of 2019, there were nearly 21,000 "large" CAFOs in the United States, defined as operations with at least 1,000 cattle, 10,000 swine or 125,000 chickens.[46]

On traditional smaller farms, animal droppings could often be naturally dispersed and absorbed by crops or pasture. At today's densely packed facilities, however, the volume of manure generated is far greater than surrounding cropland can absorb. This almost inevitably leads to the over application of manure. Rain can then sweep the excess into nearby creeks, rivers and streams. Some types of CAFOs – typically hog and dairy farms – store large volumes of manure in lagoons.[47] These lagoons can be inundated during heavy storms, causing manure to flow into nearby waterways.[48]

Overall, Texas' animal production facilities created an estimated 280 billion pounds of manure in 2000.[49] As animal populations increase, the amount of waste produced does as well. One large beef farm can

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[42] See note 33.

[43] Carrie Hribar and Mark Schultz, *National Association of Local Boards of Health, Understanding Concentrated Animal Feeding Operations and Their Impact on Communities*, 2010, archived at http://web.archive.org/web/20200306231353/https://www.cdc.gov/nceh/ehs/docs/understanding_cafos_nalboh.pdf.

[44] Food & Water Watch, *Factory Farm Nation 2015 Edition*, May 2015, archived at http://web.archive.org/web/20170708025808/https://www.foodandwaterwatch.org/sites/default/files/factory-farm-nation-report-may-2015.pdf.

[45] See note 44.

[46] U.S. Environmental Protection Agency, *NPDES CAFO Permitting Status Report - National Summary, End year 2019*, 20 July 2020, archived at https://web.archive.org/web/20210512195708/https://www.epa.gov/sites/production/files/2020-08/documents/cafo_status_report_2019.pdf.

[47] Carrie Hribar, *National Association of Local Boards of Health, Understanding Concentrated Animal Feeding Operations and Their Impact on Communities, 2010*, archived at http://web.archive.org/web/20181107054302/https://www.cdc.gov/nceh/ehs/Docs/Understanding_CAFOs_NALBOH.pdf.

[48] Kendra Pierre-Louis, "*Lagoons of pig waste are overflowing after Florence. Yes, that's as nasty as it sounds*," The New York Times, 19 September 2018.

[49] Consumer Reports, *Animal Factories: Pollution and Health Threats to Rural Texas*, May 2000, https://p2infohouse.org/ref/48/47954.pdf

generate 1.1 million tons of manure a year, or about 80% of the human waste generated in Texas.[50] That manure generates fecal dust and when it rains, fecal runoff. This contamination can reach beaches, either washing directly from manure lagoons or livestock facilities, or as runoff after it is applied to crops as fertilizer.[51]

Recreational contact with water contaminated by livestock waste is dangerous. Animal manure can contain a variety of bacterial and viral pathogens that cause disease in humans.[52] Cattle feces likely pose particular risk, and may pose risks similar to human waste.[53]

Agricultural waste likely poses additional health risk because of the heavy use of antibiotics on livestock, which has contributed to the rise of antibiotic-resistant bacteria that cause illnesses that can be difficult or impossible to treat. In EPA's 2018 review of its recreational water criteria, the agency devoted an entire chapter to the health threat posed by resistant bacteria in recreational water, writing that "[d]rug-resistant bacteria and associated genes have become an emerging concern regarding the protection of human health during recreational activities in surface waters."[54] EPA cited one study showing that water downstream from concentrated swine operations can contain high levels of enterococci and E. coli exhibiting resistance to antibiotics such as erythromycin and tetracycline.[55]

### *Other Factors:*

Runoff from development, sewage overflows, and manure from factory farms pose major threats to the safety of beaches across the state. At individual beaches, however, the causes of day-to-day bacteria levels are varied, and can include other sources.

Certain beaches are more susceptible to contamination. Factors including rainfall, water flow and physical beach layout have an impact on bacteria levels and susceptibility to contamination. EPA notes that, in recent years, "several studies have highlighted the importance of significant rainfall in determining the degree of water contamination."[56] A study in Southern California found that storms with more than 6 millimeters of rainfall "consistently led to beach water quality degradation."[57] The physical layout of beaches also impacts pollution levels. A state of California study found that enclosed

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[50] Collins, Chris, The Fern, A Texas community chokes on fecal dust from cattle feedlots, 03 February 2020, https://thefern.org/2020/02/a-texas-community-chokes-on-fecal-dust-from-cattle-feedlots/

[51] U.S. Environmental Protection Agency, *Estimated Animal Agriculture Nitrogen and Phosphorus from Manure*, archived on 22 June 2020 at http://web.archive.org/web/20200622012200/

[52] Christy Manyi-Loh et al., "*An overview of the control of bacterial pathogens in cattle manure*," J Environ Res Public Health, September 2016, doi: 10.3390/ijerph13090843.

[53] Jeffrey Soller et al., "*Estimated human health risks from exposure to recreational waters impacted by human and non-human sources of faecal contamination*," Water Research, 2010, doi:10.1016/j.watres.2010.06.049.

[54] U.S. Environmental Protection Bureau, 2017 Five-Year Review of the 2012 Recreational Water Quality Criteria, May 2018, archived at https://web.archive.org/web/20200526155704/https://www.epa.gov/sites/production/files/2018-05/documents/2017-5year-review-rwqc.pdf.

[55] See note 54.

[56] See note 54.

[57] Drew Ackerman and Stephen B. Weisberg, "Relationship between rainfall and beach bacterial concentrations on Santa Monica Bay beaches," Journal of Water and Health, 1 June 2003, doi:10.2166/wh.2003.0010.

beaches – for example beaches in enclosed bays or harbors, often with weaker currents – were five times more likely than open coastal beaches to exceed state standards for fecal bacteria.[58]

Some sources of contamination are outside of human control. Not all contamination results from human activity or pollution. Birds, aquatic animals and other forms of wildlife generate waste and bacteria.[59] This means that even pristine areas may occasionally have days where bacteria readings are high. Contamination can also result from humans using a beach for recreational purposes.

Bacteria from natural sources can be less indicative of risk. Because there are a variety of sources of fecal indicator bacteria, not all bacteria signify the same level of risk. Bacteria from wildlife may not always signify the same risk to humans as bacteria in human waste or the waste of certain livestock. One study from Epidemiology noted that some animals can shed "bacterial indicators without certain accompanying human pathogens."[60]

Indeed, fecal indicator bacteria may not always indicate the presence of fecal matter at all, as the bacteria can exist in other sources including sand, soil and marine vegetation.[61] In setting its water quality criteria and Beach Action Values, EPA considered the differences in risk posed by various bacteria sources.[62]

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[58] John Largier, Bodega Marine Laboratory, Mitzy Taggart, Heal the Bay, prepared for State of California, State Water
Resources Control Board, Clean Beaches Initiative, *Improving Water Quality at Enclosed Beaches*, June 2006, available at
https://www.waterboards.ca.gov/water_issues/programs/beaches/cbi_projects/docs/enclosed_beaches_report.
[59] See note 58.
[60] John Colford, Jr., et al., "*Water quality indicators and the risk of illness at beaches with nonpoint sources of fecal contamination*," Epidemiology, January 2007, doi: 10.1097/01. ede.0000249425.32990.b9.
[61] Gregory Imamura et al., "Wrack promotes the persistence of fecal indicator bacteria in marine sands and seawater," FEMS Microbiology Ecology, July 2011, doi: 10.1111/j.1574-6941.2011.01082.x.
[62] See note 8.

## *Texas State Data*

In Texas, 93 of 104 sampling sites[63] were potentially unsafe by EPA standards for swimming on at least one day in 2021. Of beaches where sampling took place, only 12 did not have potentially unsafe levels of contamination on at least one day. A sampling site at Ropes Park in Nueces County tested as potentially unsafe for 92 days, more days than any other site in the state, and 70 percent of the days that sampling took place. In Nueces County, the average beach was potentially unsafe for swimming on 41 percent of the days that sampling took place, a higher percentage than any other county in the state.

The GLO's Texas Beach Watch Program monitors and reports water quality information along the Texas coast and issues advisories based on *Enterococcus* bacterial levels. Advisory levels are separated into Low, Medium, and High levels as described in the Executive Summary. GLO's Texas Beach Watch Program FAQ states that these advisories are issued when bacteria levels can cause sickness and "when Enterococcus levels exceed the EPA's minimum standard, a water quality advisory is recommended." Based on those standards, one site, Cole Park, tested as High over 50% of the time. The top ten site with the highest percentage of High days were split evenly between Nueces and Brazoria Counties.

A year over year analysis shows a clear increasing trend in both the average number of days a beach is under an advisory action and the average number of days a beach is under an action due to *Enterococcus*. (See Methodology). It is worth noting that 2019 had significant increases in both metrics over 2018. The cause of action is listed as "unknown," for the vast majority of advisories in 2019 and there does not seem to be a significant rise in normal root causes or major events, for example major storms, that would lead to such a rise.

*Table 1: Top beach sites by most potentially unsafe swimming days in Texas in 2021*

| Sampling Site | County | Potentially Unsafe Days | Days with Sampling | Percentage of Sampling Days with Potentially Unsafe Water |
|---|---|---|---|---|
| Ropes Park * | Nueces | 92 | 130 | 70.77% |
| Cole Park * | Nueces | 336 | 497 | 67.61% |
| Emerald Beach | Nueces | 55 | 96 | 57.29% |
| Corpus Christi Marina | Nueces | 142 | 283 | 50.18% |
| Poenisch Park | Nueces | 46 | 94 | 48.94% |
| Quintana Beach County Park | Brazoria | 57 | 117 | 48.72% |
| Park Road 22 | Nueces | 45 | 94 | 47.87% |
| 8th Street | Brazoria | 54 | 114 | 47.37% |
| Port Aransas * | Nueces | 243 | 521 | 46.64% |
| Palacios Pavilion East | Jefferson | 46 | 105 | 43.81% |

* Beach has more than one associated testing site, which may affect the number of potentially unsafe days.

[63] Some sites were grouped together due to a combination of naming conventions and proximity. For example, "Cole Park" consists of four sampling sites covering an area of approximately one kilometer.

*Table 2: Average percentage of potentially unsafe days in Texas by county in 2022*

| County | Average percentage of days with potentially unsafe water for beaches in county | Number of tested beaches |
|---|---|---|
| Nueces | 41% | 17 |
| San Jacinto | 18% | 1 |
| Harris | 18% | 2 |
| Matagorda | 25% | 4 |
| Aransas | 24% | 4 |
| Brazoria | 22% | 9 |
| Galveston | 12% | 45 |
| Jefferson | 21% | 4 |
| Cameron | 1% | 16 |

*Table 3: Number of 2021 sampling events considered to have "High" bacterial levels by GLO*

| Sampling Site | County | Percentage of Sampling Days with Potentially Unsafe Water |
|---|---|---|
| Cole Park* | Nueces | 51.71% |
| 8th Street | Brazoria | 38.60% |
| Quintana Beach County Park | Brazoria | 38.46% |
| Emerald Beach | Nueces | 36.46% |
| Poenisch Park | Nueces | 35.11% |
| CR750 | Brazoria | 33.91% |
| Corpus Christi Marina* | Nueces | 30.39% |
| University Beach | Brazoria | 25.58% |
| Port Aransas* | Nueces | 23.80% |
| McGee Beach* | Brazoria | 22.83% |

* Beach has more than one associated testing site, which may affect the number of potentially unsafe days.


*Figure 1: Map of top ten beach sites by most potentially unsafe swimming days in Texas in 2021*

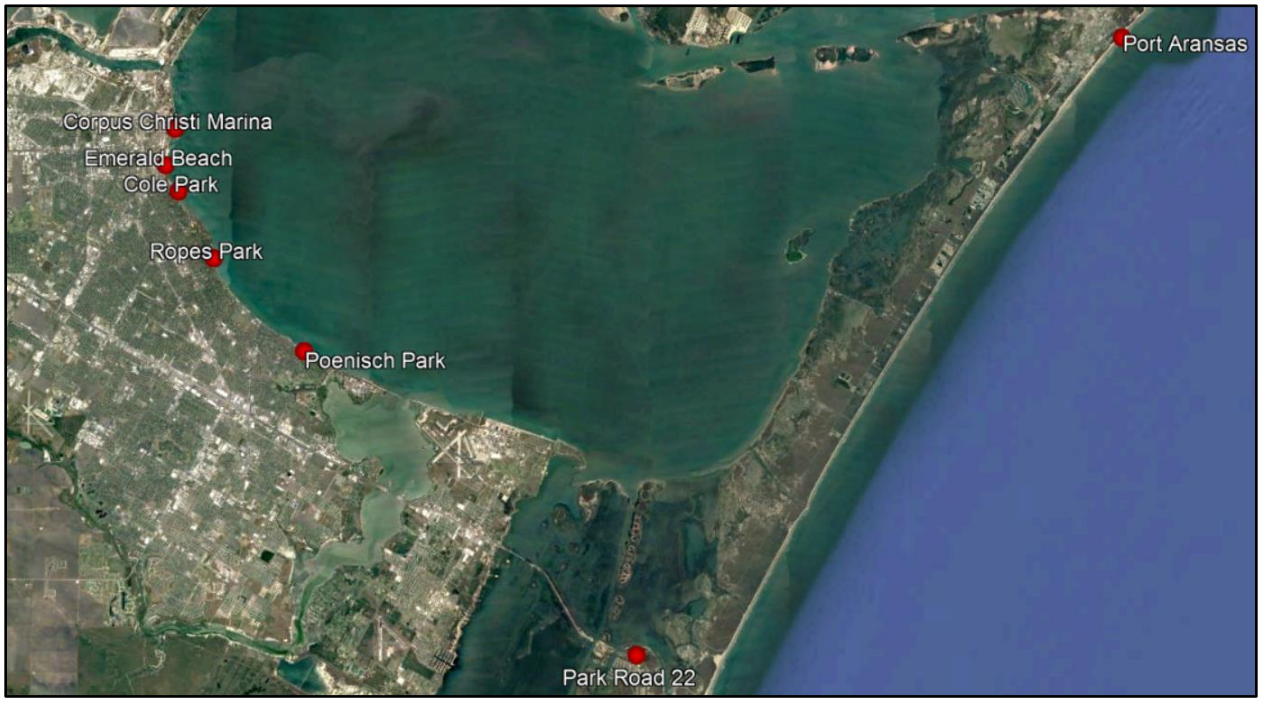


*Figure 2: Map of beaches by potentially unsafe days in 2022 close-up of Corpus Christi Bay Area.*


*Figure 3: Map of beaches by potentially unsafe days in 2022 close-up of Freeport area.*

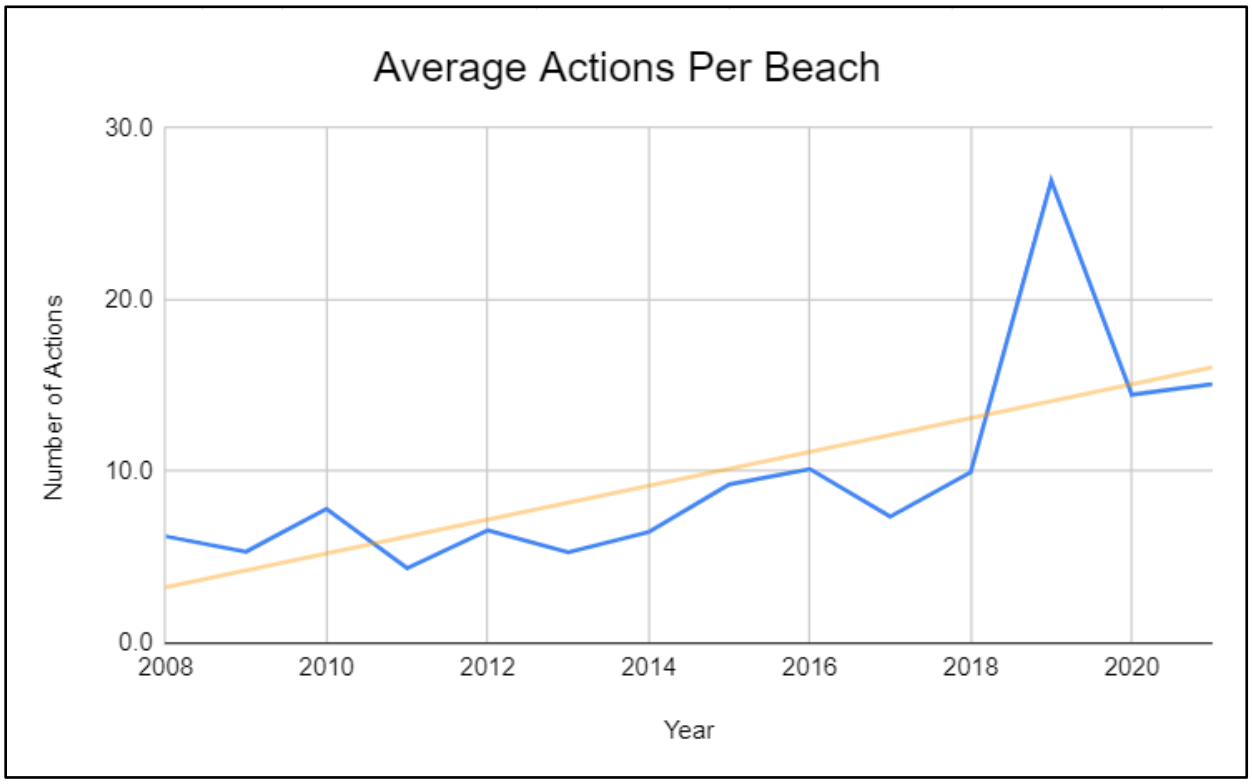


*Figure 4: Average number of annual actions per beach with trendline*

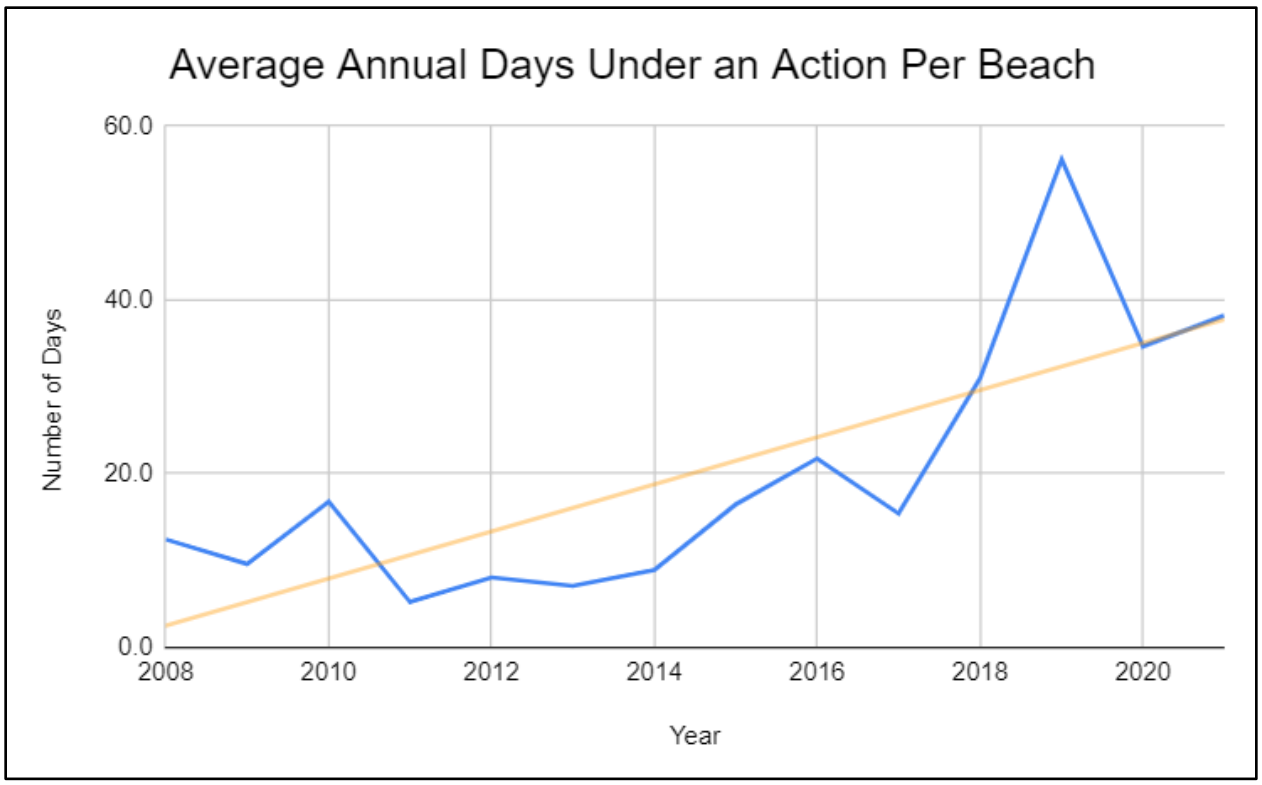


*Figure 5: Average number of annual days under action per beach with trendline*

### *How the Texas Tests for Contaminated Water*

Across Texas, beach areas are monitored on different schedules and with different levels of regularity. Data in this report come from sampling conducted by more than 40 local, state and federal agencies, and submitted to the National Water Quality Monitoring Council's Water Quality Portal. Different organizations test and submit testing data using different sampling techniques and equipment, over different schedules, and over different distributions of geography and time. Beaches in this analysis were tested between 1 and 398 times in 2018, on between 1 and 258 days. As a result, comparisons between beach sites, let alone between counties or statewide analysis, are often not meaningful. Nevertheless, beaches where testing frequently indicates unsafe levels of fecal contamination present health risks for swimmers. (See Methodology for more details.)

## *Current Policy and Actions*

TCEQ and local stakeholders are developing an implementation plan (I-Plan) to reduce bacteria on the beaches of Ropes Park, Cole Park, and Poenisch Park; respectively the first, second, and fifth most contaminated beaches by percentage of sampling days with potentially unsafe water. Additionally, Total Maximum Daily Load (TMDL) programs for waters adjacent to Ropes and Cole Park have been adopted while Poenisch Park's are being developed. TMDL is a scientifically-derived target used to determine the highest amount of various nutrients or bacteria that can be added to a waterway while keeping it healthy. The TMDL acts as a pollution budget and provides a measurable way to target efforts to protect and improve water quality. The purpose of these programs is to "restore and maintain water quality uses—such as drinking water supply, recreation, support of aquatic life, or fishing—of impaired or threatened water bodies."[64] The July 2021 TDML for Cole and Ropes parks has identified various sources of fecal contamination, but does not yet have specific recommendations for alleviating the problem.

The GLO is also taking action. They have established the Texas Coastal Nonpoint Source Pollution Program which can be used to access a number of protection plans and county level projects aimed at reducing coastal pollution.[65] The plans are at various levels of implementation and generally include a mix of federal, state, and local groups as well as volunteer organizations. The program also offers a number of technical resources, outreach programs, and direct action projects along the Texas coastal zone.

## *Conclusion and Recommendations*

In every corner of our state, Texans should be able to enjoy beaches that are clean and safe for swimming. There are many steps that communities can take to keep beaches safe.

Policymakers at every level of government should take actions to prevent dangerous pollution from reaching the beaches where Texans swim, including the following:

### *Prevent urban runoff pollution*

- Dramatically increase public investment in natural and green infrastructure features that prevent bacteria-laden pollution, such as rain barrels, permeable pavement, urban greenspace, and green roofs
- Require the use of green infrastructure in new development/redevelopment and use additional policy tools to promote its use at existing development.
- Protect and restore natural infrastructure, including riparian areas and wetlands that can filter bacteria, sediment and nutrients.

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[64] Texas Commission on Environmental Quality, Two Total Maximum Daily Loads for Indicator Bacteria at Corpus Christi Bay Beaches, Cole Park and Ropes Park, Adopted 28 July 2021, https://www.tceq.texas.gov/downloads/water-quality/tmdl/corpus-christi-beaches-recreational-97/97-as-210-corpus-cole-ropes-bacteria-tmdl-adopted-approved.pdf

[65] Texas General Land Office, *Clean Coast Texas*, Accessed 26 June 2022, https://cleancoast.texas.gov/

*Prevent sewage pollution*

• Dramatically increase public investment in fixing aging sewage systems and using green infrastructure to prevent sewage overflows by reducing the quantity or rate of water flowing into sewer systems.

• Strengthen enforcement of standards for municipal wastewater treatment, as opposed to allowing a "blending" of partially treated sewage into wastewater.

• Upgrade or relocate wastewater facilities that are in danger of overflowing during storms and floods.

• Ensure more frequent inspections and proper maintenance of residential septic systems. Prevent manure pollution.

*Prevent manure pollution*

• Enact moratoriums on new or expanded industrial-scale livestock operations, especially in watersheds already overburdened by manure pollution.

• Require best practices for reducing manure pollution from cropland, including the maintenance of conservation buffers set up around fields.

• Encourage livestock operations to raise animals on rotational pasture.

***Policymakers should also take actions to provide beachgoers with the information they need to stay safe, including the following:***

• Use the EPA's most protective "Beach Action Value" bacteria standard for posting beach advisories.

• Put in place systems for same-day water testing and warnings, particularly during times of heavy water recreation.[66]

•Increase funding for beach monitoring to ensure that state, tribal and local agencies have adequate resources to conduct testing at beaches used for recreation.

Finally, federal policymakers should maintain a strong Clean Water Act that protects all streams and other waterways that flow to our beaches and wetlands that help filter out pollution before it reaches the places where we swim.

[66] See note 15.

## *Methodology*

National beach testing data was downloaded from the National Water Quality Monitoring Council's Water Quality Data portal on 06 June 2022. Sampling data was included in this analysis if it met the following criteria:

- Result parameter CharacteristicName: Enterrococcus or Escherichia coli.
- Station parameter MonitoringLocationTypeName: Estuary (NWIS, STORET), Ocean (NWIS, STORET), or Wetland (NWIS, STORET).

Beach Action and Advisory data was downloaded from the EPA's Beach Advisory and Closing On-line Notification (BEACON) 2.0 database from 12 to 26 June 2022.

Some data cleanup and categorization were performed before conducting the analysis:

- Samples with parameter ResultConditionText of "Not Detected," "Detected Not Quantified" and other similar entries were treated as safe samples. Samples with ResultConditionText of "Present Above Quantification Limit" were treated as potentially unsafe.
- Measure values that included a "<" (less than) symbol were treated as safe samples. Measure values that included a ">" (more than) symbol were assumed to be whatever result followed the symbol.
- Certain errors in latitude and longitude values from the Water Quality Data portal were corrected.
- Measurements for which concentrations were not specified were assumed to be reported in concentration per 100 milliliters.

Jurisdictions with beaches whose monitoring data is not included in the Water Quality Data portal are not included in this analysis. Beach sites were considered "potentially unsafe" if single sample tests or daily geometric means exceeded the EPA Beach Action Value (BAV) associated with an estimated illness rate of 32 per 1,000 swimmers.[67] EPA suggests states use BAVs "as a conservative, precautionary tool for making beach notification decisions."[68]

Results reported as daily geometric means may include individual tests that exceed the BAV that would otherwise be considered "potentially unsafe" if the individual test results had been reported to the database. For enterococcus, the BAV threshold is 60 colony forming units per 100 milliliters (cfu/100mL). For E. coli the BAV is 190 cfu/100mL. For tests conducted using a quantitative polymerase chain reaction (qPCR) method, with results reported as calibrator cell equivalent (cce) per 100mL, the BAV is 640 cce/100mL. Data reported by TCEQ and NWQMC were reported in most probable number (MPN/100ml) rather than cfu/100ml. TCEQ confirmed that MPN was used interchangeably with cfu per the 2018 Texas Water Quality Standards.

For the purposes of this analysis, bacteria tests were grouped together by day, by site to determine "potentially unsafe days." If multiple tests occurred on a single day, and one of those tests exceeded the

[67] See note 8.
[68] See note 8.

safe limit for bacteria, that day was considered a “potentially unsafe day.” Tests recorded as results for “30-day Geometric Means” tests were not considered for this analysis, as those tests cannot be used to determine potentially unsafe beach days.

The average percentage of unsafe days by county, used for county comparisons, was calculated by averaging percentages of unsafe sampling days for all beaches within each county (as opposed to dividing the total number of unsafe beach days by total sampling days in the county).

Some sites with the same name were grouped. When grouped, the location of the beach was determined as the midpoint of the sites.

Maps were generated using Google Earth Pro Version 7.3.4.8642. Locations were noted using latitude/longitude from BEACON data.

Throughout the report, maps of sample sites reflect location data as submitted by testing agencies and contained in the original data source. Because of the nature of the geotagging process, sample sites displayed on maps may occasionally reflect imprecise locations.

Jurisdictions vary both in the safety thresholds they apply to beaches in making public health decisions and in the methods they use to communicate the results of beach testing. (For example, some states average the results of tests across several monitoring sites on a single beach to develop a single result for that beach that is compared with the safety threshold.) For this reason, estimates of the number of potentially unsafe beach days will often differ between this report and others issued by local and/or state governments.