TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

# AGENDA ITEM REQUEST

Consideration of an Implementation Plan
for Approval

**AGENDA REQUESTED:** August 6, 2025

**DATE OF REQUEST:** July 18, 2025

**INDIVIDUAL TO CONTACT REGARDING CHANGES TO THIS REQUEST, IF NEEDED:** Corey Bowling, Texas Register/Agenda Coordinator, General Law Division (512) 239-6089

**CAPTION: Docket No. 2024-1594-TML.** Consideration for approval of the Implementation Plan for Seven Total Maximum Daily Loads for Indicator Bacteria in the Corpus Christi Region, of the Bays and Estuaries Basin, in Nueces County. Notice of a public meeting to receive comments on the draft I-Plan was published in the February 14, 2025 issue of the *Texas Register* (50 TexReg 889). (Nicole Hall, Aubrey Pawelka; Non-Rule Project No. 2025-004-TML-NR)

**Director**

Kelly Mills
**Division Deputy Director**

Corey Bowling
**Agenda Coordinator**

# Texas Commission on Environmental Quality
Interoffice Memorandum

**To:** Commissioners **Date:** July 18, 2025

**Thru:** Laurie Gharis, Chief Clerk
Kelly Keel, Executive Director

**From:** *cml* Cari-Michel La Caille, Director
Office of Water

**Docket No:** 2024-1594-TML

**Subject:** Proposal of the Implementation Plan for Seven Total Maximum Daily Loads for Indicator Bacteria in the Corpus Christi Region for Approval
Project No. 2025-004-TML-NR

**Consideration:** Approval of the Implementation Plan (I-Plan) for seven Total Maximum Daily Loads (TMDLs) for indicator bacteria in the Corpus Christi Region, of the Bays and Estuaries Basin in Nueces County.

**Background and Current Practice:** The documents *One Total Maximum Daily Load for Bacteria in Oso Bay*[1]*, One Total Maximum Daily Load for Indicator Bacteria in Oso Creek,* and *Two Total Maximum Daily Loads for Indicator Bacteria at Corpus Christi Bay Beaches, Cole Park and Ropes Park* have been prepared as required by the federal Clean Water Act Section 303(d). The Texas Commission on Environmental Quality (TCEQ) adopted the Oso Bay TMDL on August 22, 2007, the Oso Creek TMDL on July 31, 2019, and the Corpus Christi Bay Beaches, Cole Park and Ropes Park TMDLs July 28, 2021. The United States Environmental Protection Agency approved the Oso Bay TMDL on June 6, 2008, the Oso Creek TMDL on October 25, 2019, and the Cole Park and Ropes Park TMDLs on January 31, 2022.

The I-Plan describes the strategy and activities that TCEQ and watershed partners will carry out to improve water quality in the affected watersheds. The Water Quality Planning Division respectfully requests the commission's approval of the final I-Plan. The I-Plan, combined with the TMDLs, provides local, regional, and state organizations with a comprehensive strategy for improving and maintaining water quality in the impaired watersheds.

The goal of this I-Plan is to reduce bacteria concentrations in assessment units (AUs) 2481CB_03, 2481CB_04, 2485A_01, 2485_01, 2485_02, 2485_03 and 2486_01 to the levels established in the TMDLs.

**Comments on the I-Plan Document:** TCEQ received two public comments during the comment period, which took place from February 14, 2025, through March 18, 2025.

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1 *One Total Maximum Daily Load for Bacteria in Oso Bay* was developed prior to the agency's use of AUs. This TMDL was completed for Oso Bay which now includes four AUs; 2485_01, 2485_02, 2485_03, and 2486_01.

There were no changes to the document as a result of these comments.

**Management Measures:** This I-Plan includes fifteen stakeholder-developed management measures that will be used to reduce indicator bacteria in the Corpus Christi Region.

1. Education and Outreach
2. Monitoring
3. Research
4. Wastewater Collection System Enhancements
5. Stormwater Drainage System
6. Ordinances and Regulation Improvements
7. Identify On-Site Sewage Facilities, Prioritize Problem Areas, and Systematically Work to Bring Systems into Compliance
8. Promote, Develop, and Implement Conservation Plans, Water Quality Management Plans, and Wildlife Habitat Plans
9. Promote the Management of Feral Hog Populations
10. Promote the Reduction of Illicit Dumping and Proper Disposal of Animal Carcasses
11. Promote Wastewater Collection and Treatment Systems Improvements
12. Promote Proper Management of Pet Waste
13. Promote, Develop, and Implement Actions to Restore and Repair Riparian Zones
14. Conduct Water Quality Research, Monitoring, and Sampling
15. Promote, Develop and Implement Stormwater and Green Infrastructure Programs in the Oso Watershed

**Stakeholder Involvement:** TCEQ and Texas A&M University – Corpus Christi jointly coordinated public participation in the development of both the TMDLs and the I-Plan. Forty-four public meetings have been coordinated since 2005 to keep the public informed of the project and to engage their participation in the TMDLs and I-Plan.

**Potential Controversial Concerns and Legislative Interest:** There are no controversial concerns or legislative interest at this time.

**Implementation and Reasonable Assurance:** I-Plans use an adaptive management approach that allows for the refinement or addition of methods to achieve water quality goals. This adaptive approach reasonably assures that the necessary regulatory and voluntary activities to achieve pollutant reductions will be implemented. Periodic, repeated evaluations of the effectiveness of implementation methods determine if

progress is occurring. I-Plans may be adapted as necessary to reflect needs identified in the evaluation of progress.

**Key Points in the I-Plan Approval Schedule:**
*Texas Register* publication date: February 14, 2025
Public meeting date: March 4, 2025
Public comment period: February 14, 2025 – March 18, 2025

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**Attachments:**
None

Approved: August 6, 2025
TCEQ Publication AS-504

# Implementation Plan for Seven Total Maximum Daily Loads for Indicator Bacteria in the Corpus Christi Region

Assessment Units 2481CB_03, 2481CB_04, 2485A_01, 2485_01, 2485_02, 2485_03, and 2486_01

By the Corpus Christi Regional I-Plan Coordination Committee
With Support from the Center for Coastal Studies at
Texas A&M University-Corpus Christi

Published by the Texas Commission on Environmental Quality Office of Water, Water Quality Planning Division

Prepared by the Corpus Christi Regional I-Plan Coordination Committee and the
Center for Coastal Studies at
Texas A&M University-Corpus Christi

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Total Maximum Daily Load Team
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Total maximum daily load implementation plans are also available on the Texas Commission on Environmental Quality website at:
https://www.tceq.texas.gov/waterquality/tmdl
This plan is based in part on technical reports prepared for the Texas Commission on Environmental Quality by
Texas A&M University-Corpus Christi
and in large part on the recommendations of the
Corpus Christi Regional I-Plan Coordination Committee and their Stakeholder Technical Workgroups

Organizations that took part in the development of this document include:
City of Corpus Christi
Clean Economy Coalition
Coastal Bend Bays & Estuaries Program
Coastal Bend Bays Foundation
Corpus Christi Convention and Visitors Bureau
Corpus Christi-Nueces County Public Health Department
Corpus Christi Windsurfing Association
Del Mar College
Naismith Engineering
Nueces River Authority
Surf Rider Foundation
Texas A&M University-Corpus Christi

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# Abbreviations

| | |
|---|---|
| AIA | American Institute of Architects |
| AU | assessment unit |
| BAV | Beach Action Value |
| BEACH Act | Beaches Environmental Assessment and Coastal Health |
| BMP | best management practice |
| CARP | Cole and Ropes Parks |
| CBBEP | Coastal Bend Bays and Estuaries Program |
| CBBF | Coastal Bend Bays Foundation |
| CBCOG | Coastal Bend Council of Governments |
| CBCR | Coastal Bend Cat Rescue |
| CCN | Certificate of Convenience and Necessity |
| CCS | Center for Coastal Studies at Texas A&M University Corpus Christi |
| cfu | colony-forming units |
| CHAMP | County Hog Abatement Matching Program |
| CIG | Conservation Innovation Grant |
| CIP | Capital Improvements Program |
| CMOM | Capacity, Management, Operation, and Maintenance |
| CMP | Coastal Management Program |
| CRP | Clean Rivers Program |
| CSP | Conservation Stewardship Program |
| CWA | Clean Water Act |
| CWSRF | Clean Water State Revolving Fund |
| *E. coli* | *Escherichia coli* |
| EDAP | Economically Distressed Areas Program |
| EEG | Environmental Education Grant |
| EPA | Environmental Protection Agency |
| EQIP | Environmental Quality Incentives Program |
| FOG | fats, oil, and grease |
| FSE | food service establishment |
| GI | green infrastructure |
| GIS | geographic information system |
| HEM | hexane extractible material |
| I-Plan | implementation plan |
| I/I | inflow and infiltration |
| LA | load allocation |
| LID | Low Impact Development |
| L | liter |
| mL | milliliter |
| MPN | most probable number |
| MS4 | municipal separate storm sewer system |

| | |
|---|---|
| NSWCD | Nueces Soil & Water Conservation District |
| NELAP | National Environmental Laboratory Accreditation Program |
| NOAA | National Oceanic and Atmospheric Administration |
| NPS | Nonpoint source |
| NRA | Nueces River Authority |
| NRCS | Natural Resources Conservation Services |
| O&M | Operation and maintenance |
| OSSF | On-site sewage facility |
| Plan CC | Corpus Christi's Comprehensive Plan |
| PSA | Public Service Announcement |
| QAPP | Quality Assurance Project Plan |
| RCPP | Regional Conservation Partnership Program |
| RDII | Rainfall Dependent Inflow/Infiltration |
| RFP | Request for Proposal |
| SARE | Sustainable Agriculture Research and Education |
| SEP | Supplemental Environmental Projects |
| SSO | Sanitary sewer overflow |
| SSOI | Sanitary Sewer Overflow Initiative |
| SWCD | Soil and water conservation districts |
| SWMP | Stormwater Management Program |
| TAMUCC | Texas A&M University-Corpus Christi |
| TBWP | Texas Beach Watch Program |
| TCEQ | Texas Commission on Environmental Quality |
| TDA | Texas Department of Agriculture |
| TGLO | Texas General Land Office |
| TIDRC | Texas Illegal Dumping Resource Center |
| TMDL | Total Maximum Daily Load |
| TNR | Trap-Neuter-Release |
| TPDES | Texas Pollutant Discharge Elimination System |
| TPWD | Texas Parks and Wildlife Department |
| TSSWCB | Texas State Soil and Water Conservation Board |
| TST | Texas Stream Team |
| TWDB | Texas Water Development Board |
| TWRI | Texas Water Resources Institute |
| TWS | Texas Wildlife Service |
| TxDOT | Texas Department of Transportation |
| UA | urban area |
| U.S. | United States |
| USDA | United States Department of Agriculture |
| UDC | Unified Development Code |
| WQMP | Water Quality Management Plan |
| WWD | Water and Waste Disposal |
| WWTF | Wastewater Treatment Facility |

# Executive Summary

The goal of this implementation plan (I-Plan) is to restore the primary contact recreation use 1 by reducing concentrations of indicator bacteria to levels established in the total maximum daily loads (TMDLs). Implementation activities within this implementation plan specifically target the assessment units (AUs) in three TMDL reports:

- *One Total Maximum Daily Load for Bacteria in Oso Bay*[1]
  - Oso Bay (AUs 2485_01, 2485_02, and 2485_03)
  - Blind Oso Bay (AU 2486_01)
- *One Total Maximum Daily Load for Indicator Bacteria in Oso Creek*
  - Oso Creek (AU 2485A_01)
- *Two Total Maximum Daily Loads for Indicator Bacteria at Corpus Christi Bay Beaches, Cole Park and Ropes Park*
  - Cole Park (AU 2481CB_03)
  - Ropes Park (AU 2481CB_04)

This I-Plan describes the steps that watershed stakeholders and the Texas Commission on Environmental Quality (TCEQ) will take toward achieving pollutant reductions identified in the TMDL reports. This I-Plan also outlines the schedule for implementation activities.

Enterococci is the indicator bacteria used to assess attainment of the contact recreation use in salt water. The criterion for assessing attainment of the contact recreation use is expressed as the number of bacteria, typically given as colony-forming units (cfu). For tidal waterbodies, the primary contact recreation 1 use is not attained when the geometric mean of indicator bacteria samples exceeds the geometric mean criterion of 35 cfu per 100 milliliters (mL) for Enterococci in salt water. Oso Creek, Oso Bay, and Blind Oso Bay are assessed using the criterion of 35 cfu per 100 mL.

Cole Park and Ropes Park are recreational beaches and are assessed using the criterion of 104 cfu per 100 mL of Enterococci, which United States Environmental Protection Agency (EPA) has accepted as a Beach Action Value (BAV) to issue beach advisories under the Texas Beach Watch Program (TBWP). This methodology lists a water body as impaired when more than 25% of the days sampled exceed the BAV of 104 cfu per 100 mL. Both waterbodies are listed as not supporting the primary contact recreation 1 use, because greater than 25% of the days sampled exceed the BAV.

This I-Plan includes management measures for two separate watershed areas, Cole and Ropes Parks (herein referred to as CARP), and Oso Bay and Oso Creek (herein referred to as Oso). CARP includes six management measures (33 management measure

[1] This TMDL was developed on the segment level, TCEQ now assesses and develops TMDLs by AU, so the original TMDL now applies to the four AUs.

activities) that stakeholders will use to reduce bacteria in the watershed. This I-Plan also includes nine management measures that stakeholders will use to reduce bacteria in the Oso watershed. Management measures are related to managing nonpoint sources (NPS) (mostly unregulated), such as pet or wildlife fecal waste in the watershed.

# Summary of Management Measures

For each of the measures chosen for CARP and Oso, this plan names the responsible parties, technical and financial needs, monitoring and outreach efforts, and a schedule of activities. The timeline for most activities is years 1 through 5. Implementing management measures will depend on the availability of funding. The management measures in this I-Plan are:

## CARP Management Measures

1) Education and Outreach
2) Monitoring
3) Research
4) Wastewater Collection System Enhancements
5) Stormwater Drainage System
6) Ordinances and Regulation Improvements

## Oso Management Measures

1) Identify On-site Sewage Facilities (OSSFs), Prioritize Problem Areas, and Systematically Work to Bring Systems into Compliance
2) Promote, Develop and Implement Conservation Plans, Water Quality Management Plans and Wildlife Habitat Plans
3) Promote the Management of Feral Hog Populations
4) Promote the Reduction of Illicit Dumping and Proper Disposal of Animal Carcasses
5) Promote Wastewater Collection and Treatment Systems Improvements
6) Promote the Proper Management of Pet Waste
7) Promote, Develop, and Implement Actions to Restore and Repair Riparian Zones
8) Conduct Water Quality Research, Monitoring, and Sampling
9) Promote, Develop and Implement Stormwater and Green Infrastructure (GI) Programs in the Oso Watershed

Stakeholders and TCEQ will review progress under TCEQ's adaptive management process. The plan may be adjusted periodically as a result of progress reviews.

# Introduction

To keep Texas' commitment to restore and maintain water quality in impaired rivers, lakes, and bays, TCEQ works with stakeholders to develop an I-Plan for each adopted TMDL. A TMDL is a technical analysis that:

- Determines the amount of a particular pollutant that a water body can receive and still meet applicable water quality standards.
- Sets limits on categories of sources that will result in achieving standards.

This I-Plan is designed to guide activities that may achieve water quality goals for the CARP and Oso watersheds, as defined in their respective TMDL reports. It is a flexible tool that governmental and nongovernmental organizations involved in implementation use to guide their activities to improve water quality. The participating partners may accomplish the activities described in the plan through rule, order, guidance, or other appropriate formal or informal action.

Participating partners in this project were historically the CARP Bacteria Reduction I-Plan Coordination Committee and the Oso Bay/Oso Creek Watershed Stakeholder Coordination Committee. These committees voted to combine and are now known as the Corpus Christi Regional Coordination Committee. This committee is composed of stakeholder groups of interested citizens, private organizations, local businesses and federal, state, and local governments who are working together to improve water quality in the Corpus Christi region. Appendix C contains Resolutions and Letters of Support for the I-Plan. TCEQ worked together with the CARP and Oso Coordination Committees to develop this I-Plan (See Appendix B for a list of members).

This I-Plan contains the following components:

- Description of management measures that will be implemented to achieve the water quality target.
- Schedule for implementing activities.
- A tracking and monitoring plan to determine the effectiveness of the management measures undertaken.
- Measurable outcomes and other considerations TCEQ and stakeholders will use to decide whether the I-Plan has been properly executed, water quality standards are being achieved, or the plan needs to be modified.
- Communication strategies TCEQ will use to share information with stakeholders.
- Review strategies that stakeholders will use to periodically review and revise the plan to ensure progress in improving water quality.

# Watershed Overviews

## CARP Watershed

Since its frontier beginnings in 1519 and incorporation in 1852, the City of Corpus Christi has been a pathway to the Americas and is intrinsically linked to its bays, rivers, creeks, estuaries, and waterways (Handbook of Texas Online, 1952).

The Port of Corpus Christi ranks sixth in the nation for overall tonnage, ninth in foreign trade and eight in domestic trade. In all, shipping activity at the port accounted for $16.9 billion in trade in 2015, 89% more than in 2003 ($9 billion) (Texas Comptroller of Public Accounts, 2016). These waters play an increasingly important role in the economic stability and success of the City of Corpus Christi. Corpus Christi Bay is also a significant draw for tourism, both on the north shore, as well as the downtown recreational areas, particularly around the Cole Park and Ropes Park beaches.

In 2008, based on data collected under the TBWP, EPA listed Corpus Christi Bay (Segment 2481) on the 303(d) List of Impaired Waters for bacteria, and subsequently categorized the entire water body as Category 5a, meaning a TMDL would be scheduled. Upon request by TCEQ, EPA reconsidered listing the entire Corpus Christi Bay segment and changed the listing to more accurately include only beaches at Cole Park and Ropes Park, designating them as AUs 2481CB_03 and 2481CB_04, respectively (Figure 1).

In addition, the listing category for these AUs changed to Category 5c, meaning additional bacteria data were needed before a TMDL could be conducted. These actions resulted in the establishment of the project *TMDL Investigation for Bacteria in Corpus Christi Bay Beaches* with funding from TCEQ. In 2010, TCEQ subsequently reclassified the bacteria impairments at Cole Park and Ropes Park to Category 5a, meaning a TMDL would be scheduled for the beaches. The first portion of this I-Plan addresses methods to help reduce bacteria in the watersheds of those impaired AUs. The watershed consists of 12 subwatersheds, which range in size from seven to 2,041 acres, totaling 4,412 acres of urban land that discharges to Corpus Christi Bay.


**Figure 1. Map of the CARP TMDL Watershed**

## Cole Park – AU 2481CB_03

Cole Park is a 43-acre public park owned and operated by the City of Corpus Christi. The park sits on the edge of Corpus Christi Bay (Figure 2). The park's facilities include three parking lots, a skate park, playground, fishing pier, amphitheater, restrooms, park benches, and picnic tables. Windsurfers and kiteboarders use Oleander Point, at the south end of Cole Park, for bay access. The shoreline consists of approximately 1,800 feet of rock rubble, 300 ft of sandy beach, and the remainder consists of concrete bulkhead with large rocks and obstructions, with little to no access to the water.

The Louisiana Avenue drainage system flows into the Louisiana Parkway Outfall which is the largest stormwater outfall in Cole Park. Five other stormwater outfalls are present within the boundaries of the park, draining the smaller subwatersheds.

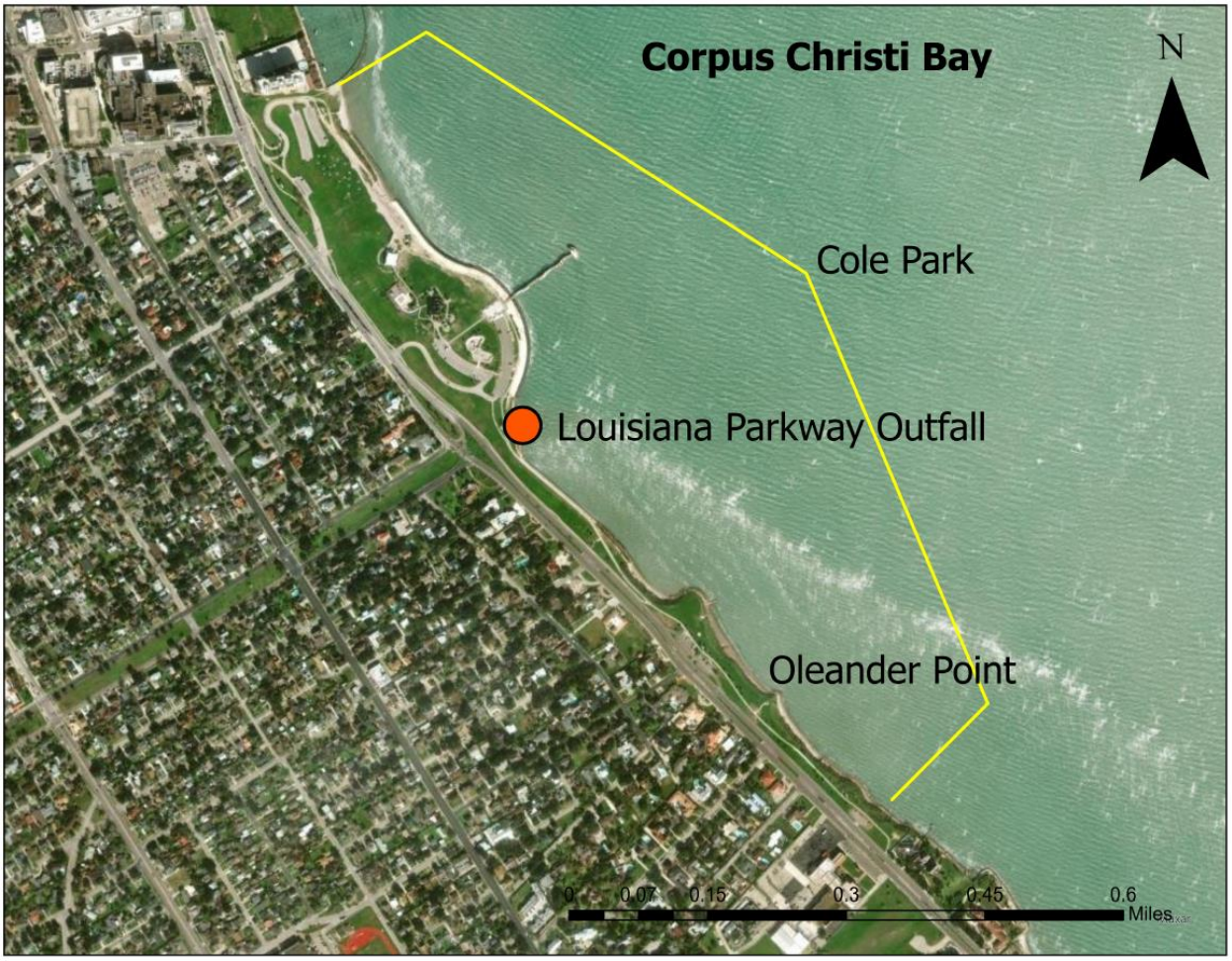


**Figure 2. Cole Park with the Louisiana Parkway stormwater outfall and Oleander Point**

## Ropes Park – AU 2481CB_04

Ropes Park is a 3.5-acre public park owned and operated by the City of Corpus Christi. The park sits on the edge of Corpus Christi Bay (Figure 3). Facilities include a parking lot, a stairway to the water, and park benches. Windsurfers commonly use Ropes Park for bay access to launch their equipment. There are approximately 1,000 ft of shoreline. Where the stairway meets the shore there are 250 ft of sandy beach with the remainder (500 ft to the north and 250 ft to the south) composed of large pieces of concrete rubble. The park sits on top of a bluff approximately 30 ft high overlooking the water.

There are two stormwater outfalls located in Ropes Park, offering drainage to two small subwatersheds totaling 36.6 acres. Brawner Parkway Outfall is a large stormwater outfall located approximately 850 ft south of Ropes Park, which drains the largest subwatershed in the Ropes Park watershed.

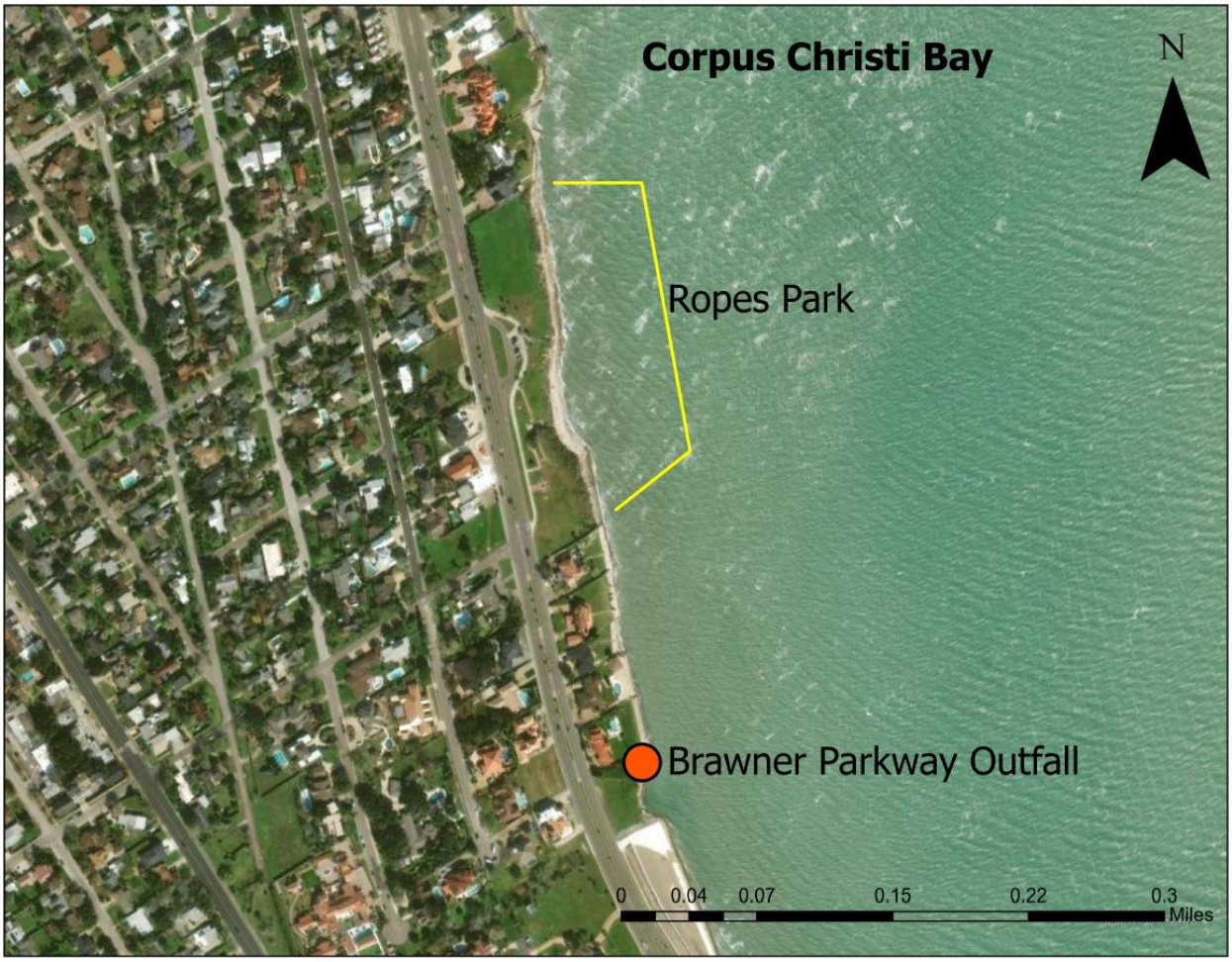


**Figure 3. Ropes Park and the Brawner Parkway stormwater outfall**

# Summary of the CARP TMDLs

Table 1 summarizes the allocations developed for *Two Total Maximum Daily Loads for Indicator Bacteria at Corpus Christi Bay Beaches, Cole Park and Ropes Park* (TCEQ, 2021). See the TMDL report[2] for additional background information, including the problem definition, endpoint identification, source analysis, linkages between sources and receiving waters, and pollutant load allocations (LA).

**Table 1. TMDL Allocation Summary at Cole Park and Ropes Park**

| AU | TMDL | $WLA_{WWTF}$[1] | $WLA_{SW}$[2] | $LA^{3}_{TOTAL}$ | MOS[4] |
|---|---|---|---|---|---|
| Cole Park 2481CB_03 (Beach ID TX259473) | 1,186 | 0 | 734 | 273 | 179 |
| Ropes Park 2481CB_04 (Beach ID TX821303) | 5,007 | 0 | 4,199 | 146 | 662 |

[2] 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

All loads expressed in billion cfu/day Enterococci.

[1] $WLA_{WWTF}$: wasteload allocation for WWTFs

[2] $WLA_{SW}$: wasteload allocation for stormwater

[3] LA: load allocation

[4] MOS: margin of safety

# Oso Watershed

The Oso watershed is approximately 235 square miles in Nueces County, Texas (Figure 4). Detailed information about land use and land cover, population and future growth, permits within the watershed, as well as bacteria data and data analysis, can be found in the Technical Support Document for the Oso Creek watershed (TCEQ, 2017), the monitoring final report for Oso Bay (TCEQ, 2015), and the TMDLs for Oso Bay and Oso Creek (TCEQ, 2007 and TCEQ, 2019).

## Oso Bay

Oso Bay is a shallow tertiary bay of about 2,963 acres that empties into Corpus Christi Bay. In 2002, fecal coliform data indicated that Oso Bay supported contact recreation, however Enterococci data were not sufficient for a complete assessment. In the 2004 Texas Water Quality Inventory and 303(d) List, Oso Bay was identified as impaired for contact recreation based on both Enterococci and fecal coliform data (Table 2) and was placed in Category 5a of the 303(d) list.

### Summary of the Oso Bay TMDL

This section summarizes the information developed for *One Total Maximum Daily Load for Bacteria in Oso Bay, Segment 2485* (TCEQ, 2007). See the TMDL report[3] for additional background information, including the problem definition, endpoint identification, source analysis, linkages between sources and receiving waters, and pollutant load allocations.

Based on TMDL (TCEQ, 2007) analyses, bacteria concentrations significantly exceeding contact recreation criteria occur only in the portion of Oso Bay known as the Blind Oso, and those concentrations are the result of dry-weather loads. TCEQ believes the source of the dry weather loads to be the many waterfowl and shorebirds that inhabit the Blind Oso. The Blind Oso, which is included on the Texas Parks and Wildlife Department's (TPWD) Great Texas Coastal Birding Trail, is a highly popular bird-watching location. A municipal WWTF discharges to the Blind Oso area, but TCEQ did not find it to be a significant contributor to elevated bacteria concentrations in the bay.

Since the Blind Oso area differed in physical characteristics from Oso Bay, the segment boundary for Oso Bay was evaluated further and determined to be its own segment (Segment 2486, AU 2486_01). This change in the segment boundary required a revision to the Texas Surface Water Quality Standards.

[3] https://www.tceq.texas.gov/downloads/water-quality/tmdl/oso-bay-creek-recreational-67/67-oso-bay-bacteria-tmdl-adopted.pdf

Table 2 summarizes the TMDLs calculated for Oso Bay at multiple flow regimes developed for *One Total Maximum Daily Load for Bacteria in Oso Bay, Segment 2485.*

**Table 2. Oso Bay TMDLs for multiple flows**

| Percent of days when net flow is less than or equal to selected value >> | Selected Flow Value (cubic ft/second) | Daily Max Load ($10^{12}$ org/day) |
|---|---|---|
| 10% | 2.64 | 3.94436 |
| 26% | 3.55 | 5.30326 |
| 50% | 5.28 | 7.89038 |
| 74% | 9.78 | 14.60087 |
| 90% | 36.17 | 53.98549 |
| 100% | 10,009.90 | 14,889.28952 |

# Oso Creek

Oso Creek (2485A) is an unclassified tidal stream located south of Corpus Christi, Texas that feeds into Oso Bay (Segment 2485), and then into Corpus Christi Bay (Segment 2481). As depicted in Figure 4, there are three unclassified water bodies of Oso Creek, including two unnamed tributaries (2485B and 2485C), and West Oso Creek (2485D).

Oso Creek begins near the City of Robstown and flows 24.9 miles southeast to Oso Bay in the City of Corpus Christi. It is the main channel for more than 60 miles of natural and constructed drainage. The creek's non-tidal section is 14.3 miles long, which then flows into a 10.6-mile tidal section, before discharging to Oso Bay.

The entire Oso Creek (2485A) watershed, including the tributaries, drains an area of approximately 133,833 acres (209.1 square miles) exclusively within Nueces County, making up 24.4% of the county land area. TCEQ first identified the bacteria impairment within Oso Creek in the 2002 Texas Integrated Report, and then in each subsequent edition of the Texas Integrated Report through 2020.

# Summary Oso Creek TMDL

Table 3 summarizes the allocations, expressed as the most probable number (MPN) in billions of Enterococci per day, developed for *One Total Maximum Daily Load for Indicator Bacteria in Oso Creek, Segment 2485A* (TCEQ, 2019). See the TMDL report[4] for additional background information, including the problem definition, endpoint identification, source analysis, linkages between sources and receiving waters, and pollutant load allocations.

**Table 3. TMDL Allocation Summary for Oso Creek**

| AU | TMDL | $WLA_{WWTF}$[1] | $WLA_{SW}$[2] | LA[3] | MOS[4] |
|---|---|---|---|---|---|
| 2485A_01 | 122.068 | 30.343 | 26.748 | 58.874 | 6.103 |

[4] https://www.tceq.texas.gov/downloads/water-quality/tmdl/oso-bay-creek-recreational-67/67-oso-creek-bacteria-tmdl-adopted-approved.pdf

Load units expressed as billion MPN/day Enterococci

[1] $WLA_{WWTF}$: wasteload allocation for WWTFs, includes Future Growth

[2] $WLA_{SW}$: wasteload allocation for stormwater

[3] LA: load allocation

[4] MOS: margin of safety

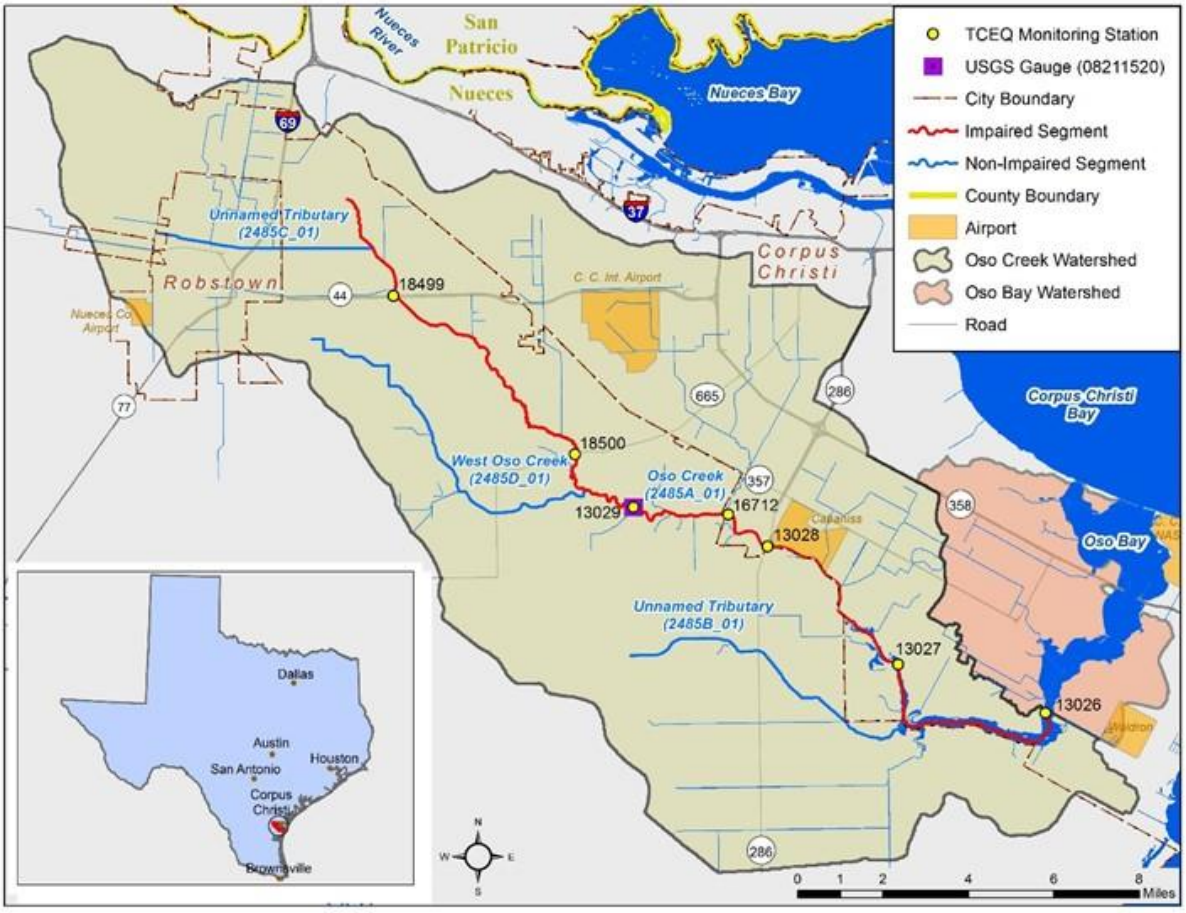


**Figure 4. Map of the Oso Creek and Oso Bay watersheds**

# Implementation Strategy

This I-Plan documents six management measures (33 management measure activities) to reduce bacteria loads in the CARP watershed and nine management measures to reduce bacteria loads in the Oso watershed.

Management measures were selected based on feasibility, costs, support, and timing. Activities can be implemented in phases based on the needs of the stakeholders, availability of funding, and the progress made in improving water quality.

Stakeholders recognize that to be effective, activities across several strategies should be implemented simultaneously or in conjunction with each other. Some activities are necessary precursors to others, and the results from some activities will lead to decision making in the planning process for subsequent actions.

The CARP Coordination Committee has identified Management Measure Activity 3.2 - Bacterial Source Tracking as the first priority activity for implementation. Because many of the management measures recommended in this I-Plan for CARP address specific potential bacterial sources, results from bacterial source tracking will guide the prioritization and implementation of subsequent activities and allow for more targeted allocation of resources throughout implementation.

# Adaptive Implementation

All I-Plans use an adaptive management approach in which stakeholders periodically assess management measures for efficiency and effectiveness. This adaptive management approach is one of the most crucial elements of the I-Plan. The iterative process of evaluation and adjustment ensures continuing progress toward achieving water quality goals and expresses stakeholder commitment to the process.

Stakeholders will periodically assess progress using the schedule of implementation, interim measurable milestones, water quality data, and regular stakeholder meetings. If periodic assessments find that insufficient progress has been made or that implementation activities have not improved water quality, the implementation strategy can be adjusted.

# Activities and Milestones

The CARP Coordination Committee formed four work groups to determine appropriate activities and schedules to accomplish the management measures described in this I-Plan for CARP. The work groups formed were:

1) Education and Outreach
2) Monitoring and Research
3) City Infrastructure
4) Ordinances and Regulations

Collectively, the CARP Coordination Committee and work groups held 61 meetings, from 2011 through 2023, to develop this I-Plan. The planned implementation activities concerning CARP are described in the following section.

For Oso, TCEQ contracted with the Center for Coastal Studies at Texas A&M University Corpus Christi (CCS). CCS held a total of 42 meetings from 2014 through 2018. Five work groups were formed as a result of those meetings to help determine appropriate activities and schedules to accomplish the management activities described in this I-Plan for Oso. The five work groups were:

1) Education and Outreach
2) Science and Technology
3) Ordinance and Regulations
4) Infrastructure and Planning

5) Agriculture, Wildlife, and Feral Hogs

Each work group developed detailed, consensus-based action plans. This I-Plan includes surface water quality monitoring activities to identify unregulated sources of bacteria, technical analysis of management measures to predict efficiency of possible best management practices (BMPs), and stakeholder guidance to review possible activities for adaptive management. BMPs and participation in existing conservation and cost-share management programs are the most feasible options to reduce bacteria levels. Encouraging the implementation of BMPs in subwatersheds where commercial and residential development has occurred, and there is a high density of pets, could also lower bacteria levels even more. In addition, the I-Plan outlines potential effective partnerships with local entities to implement the proposed management measures.

Each committee and workgroup for both CARP and Oso developed detailed, consensus-based action plans for their respective watersheds. The planned implementation activities for CARP are described in the following section, while the planned implementation activities for Oso are described in the latter part of the document.

# CARP Management Measures

There are six management measures (33 management measure activities) for the CARP watershed.

## Management Measure Activities

*1.0) Education and Outreach*

- *1.1) Promote Watershed Education and Public Awareness in Corpus Christi*
- *1.2) Anti-Littering "Leave It Better Than You Found It."*
- *1.3) Pet Waste Disposal*
- *1.4) Prevent Intentional Dumping and Disposal*
- *1.5) Slow the Flow (Low Impact Development) Initiative*
- *1.6) Install Additional Signage to Alert the Public of Potential Health Risks at Cole Park and Ropes Park After Rain Events*

*2.0) Monitoring*

- *2.1) Continue Sampling Enterococci Levels at Cole Park and Ropes Park*
- *2.2) Collect Rainfall Data Near Cole Park and Ropes Park*
- *2.3) Conduct Stormwater Outfall Flow Sampling*

*3.0) Research*

- *3.1) Evaluate Methods to Remove Bacteria with Green Infrastructure*
- *3.2) Bacterial Source Tracking*

- *3.3) Evaluate the Effectiveness of Public Utility Programs and Projects*
- *3.4) Investigate New Data Analysis Methodologies for Assessment and Listing of Recreational Beaches on the 303(d) List*
- *3.5) Identify Water Flow Patterns in Corpus Christi Bay at Ropes Park Using Dye Testing*
- 3.6) *Investigate Alternative Sampling Dates for the Texas Beach Watch Program*

*4.0) Wastewater Collection System Enhancements*

- *4.1) Continue and Enhance the Existing Fats, Oil, and Grease (FOG) Program*
- *4.2) Continue and Expand the Notification System for Monitoring Sanitary Sewer Overflows (SSOs)*
- *4.3) Continue and Expand Collection System Line Cleaning, Inspection, Repair and Rehabilitation*
- *4.4) Implement an Inflow and Infiltration (I/I) Study*
- *4.5) Continue Hydraulic Modeling of the Collection System*

*5.0) Stormwater Drainage System*

- *5.1) Continue Existing Stormwater Programs*
- *5.2) Continue Drainage System Line Cleaning, Inspection, Repair and Rehabilitation*
- *5.3) Determine Effectiveness of Stormwater Retrofits to Remove Bacteria*
- *5.4) Enhance Major Outfall Assessment and Repair Program*
- *5.5) Support and Encourage the Stormwater Master Plan*

*6.0) Ordinances and Regulation Improvements*

- *6.1) Pre-Sale Inspection and Testing Program of Private Residential Sewer Laterals*
- *6.2) Cross-connections Inspection Program*
- *6.3) Establishment of a Pilot Sewer Lateral Inspection and Testing Program for Commercial Property*
- *6.4) Improve Grease Trap Standards*
- *6.5) Strengthen Current Animal Control Ordinances Relating to the Removal and Disposal of Pet Wastes*
- *6.6) Implement Measures to Control Feral Cats, Rodents, and Nuisance Animals*
- *6.7) Develop a Program to Advise Television News Viewers of Bacteria Danger Levels in the Water*
- *6.8) Propose Access Restrictions to Bay Waters from City Parks and Other Bayfront City Properties During Periods of Public Health Risks*
- *6.9) Propose, Adopt and Enforce Additional Solid Waste Ordinances*

*6.10) Explore Adoption of Additional Low Impact Development (LID) Standards that will Reduce Stormwater Runoff from Areas of New Development or Significant Redevelopment*

# Management Measure 1.0: Education and Outreach

The purpose of this management measure is to reduce excessive bacteria loading at Cole Park and Ropes Park beaches through sustained education and outreach programs, specifically targeting environmental stewardship, green thinking, and cleanliness campaigns. These programs should address the critical aspects of education and outreach. Educational programs must be created so they adhere to core learning objectives that reinforce knowledge and understanding of environmental stewardship. Outreach programs should be created and adopted to ensure full coverage of the diverse demographic and socioeconomic background that the City of Corpus Christi represents. Partnerships must be established across government, public, business, industry, non-profit organizations, community associations, and academic institutions that will strengthen and sustain commitment and involvement for this plan. Management measure 1.0 activities 1.1 through 1.5 are further detailed in the Communication Campaign[5] document, created by CARP stakeholders in 2017.

The Education and Outreach workgroup recommended six initial activities for this I-Plan management measure:

1.1) *Promote Watershed Education and Public Awareness in Corpus Christi*

1.2) *Anti-Littering "Leave It Better Than You Found It"*

1.3) *Pet Waste Disposal*

1.4) *Prevent Intentional Dumping and Disposal*

1.5) *Slow the Flow (Low Impact Development) Initiative*

*1.6) Install Additional Signage to Alert the Public of Potential Health Risks at Cole Park and Ropes Park After Rain Events*

A community support system will be developed to sponsor and implement education and outreach measures that can improve water quality in the CARP watershed. This support system will include funding, volunteers and partnerships with local organizations to implement cleanups, educational events, outreach activities and more. In year 1 they will revisit technical and financial assistance opportunities to develop a catalog of resources available to the community, to help them reach their implementation goals.

## Technical Assistance for Management Measure 1.0

Technical assistance sources for Management Measure 1.0 include governmental, academic, and nonprofit entities with programs that support environmental education

[5] https://www.tceq.texas.gov/downloads/water-quality/tmdl/corpus-christi-beaches-recreational-97/carp_communicationcampaign.pdf

for the public, like those listed as Responsible Parties in each management measure activity.

## Financial Assistance for Management Measure 1.0

Financial assistance to implement Management Measure 1.0 would come from federal, state, and local governmental and nonprofit entities with programs funding environmental education for the public. These programs include:

- **CWA Section 319(h) Grants**: EPA provides grant funding to Texas to implement the state's approved NPS Management Program and is administered by TCEQ and Texas State Soil and Water Conservation Board (TSSWCB). The EPA-approved Texas program provides the framework for determining which activities are eligible for funding under Clean Water Act (CWA) Section 319(h). In general, these activities include non-regulatory programs and are related to controlling NPS pollution. EPA-approved NPS programs cover costs associated with technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess success of specific NPS projects. (EPA, 2022)
- **Environmental Education Grants – EPA**: Under the Environmental Education Grants (EEG) Program, the EPA seeks grant proposals from eligible applicants to support environmental education projects that promote environmental stewardship and help develop knowledgeable and responsible students, teachers, and citizens. This grant program provides financial support for projects that design, demonstrate, and/or disseminate environmental education practices, methods, or techniques as described in requests for proposals. Under this program, EPA has distributed between $2 million and $3.5 million in grant funding per year since 1992.
- **Coastal Management Program**: The Coastal Management Program (CMP), administered by the National Oceanic and Atmospheric Administration (NOAA) and Texas General Land Office (TGLO), is a voluntary partnership between the federal government and U.S. Coastal and Great Lake states and territories. It is authorized by the Coastal Zone Management Act of 1972 to address national coastal issues. The Act provides funding for protecting, restoring, and responsibly developing our nation's diverse coastal communities and resources. To meet the goals of the Act, the CMP takes a comprehensive approach to coastal resource management—balancing the often competing, and occasionally conflicting, demands of coastal resource use, economic development, and resource conservation. Some of the key elements of the CMP include protecting natural resources, managing development in high hazard areas, giving development priority to coastal-dependent uses, providing public access for recreation, and coordinating state and federal actions.
- **Coastal Bend and Bays Estuaries Program**: The Coastal Bend and Bays Estuaries Program (CBBEP) is a non-regulatory, partnership-led effort working with industry, environmental groups, bay users, local governments and resource

managers to protect and restore the health and productivity of the region's bays and estuaries.

- **Urban Water Small Grants Program**: The objective of the Urban Waters Small Grants Program, administered by EPA, is to fund projects that will foster a comprehensive understanding of local urban water issues, identify and address these issues at the local level, and educate and empower the community. The Urban Waters Small Grants Program seeks to help restore and protect urban water quality and revitalize adjacent neighborhoods by engaging communities in activities that increase their connection to, understanding of, and stewardship of local urban waterways.
- **TCEQ Supplemental Environmental Projects**: The Supplemental Environmental Projects (SEP) program, administered by TCEQ, directs fines, fees, and penalties for environmental violations toward environmentally beneficial uses. Through this program, a respondent in an enforcement matter can choose to invest penalty dollars in improving the environment, rather than paying into the Texas General Revenue Fund. Program dollars may be directed to OSSF repair, trash dump clean up, and wildlife habitat restoration or improvement, among other things. Program dollars may be directed to entities for single, one-time projects that require special approval from TCEQ or directed entities (such as Resource Conservation and Development Councils) with pre-approved "umbrella" projects.
- **Coastal Bend Community Foundation Grants**: Donors in the Coastal Bend, through both current and testamentary gifts, have enabled the Foundation to enhance and improve the quality of life through grants to area nonprofit organizations. The Foundation's grants from unrestricted funds cover a broad spectrum of projects, from the Arts to Zoology.
- **American Institute of Architects Grants**: Multiple architectural grants are offered through the American Institute of Architects (AIA) to fund new architectural ideas, including the Young Architects Forum- Large Firm Roundtable Future Forward Grant.

## Management Measure Activity 1.1: Promote Watershed Education and Public Awareness in Corpus Christi

This management measure activity seeks to create, implement, and sustain educational programs within the community that increase awareness of the impact human actions can have on the quality of local waterways.

## Education Component

Education for this management measure activity will:

- Improve community understanding of where their water goes through an introductory public education campaign, e.g., "Where Does the Water Go?", to include wastewater effluent, stormwater runoff, and general information about the ways bacteria and other pollutants can enter waterways. The campaign will

target practices that can ensure clean water and foster a sense of local pride related to quality of local waterways.

- Produce a series of public service announcements (PSAs) that could be used in media campaigns, billboards, radio, and TV advertising educating the public about water quality in Corpus Christi Bay. The topics should be similar and align with the interim measurable milestone and strategy goals (Table 4).
- Develop an education and awareness program (funding, volunteers, and partnerships with local organizations) for the sponsoring of water quality improvement projects such as community clean-ups, continuation of the "Beach to Bay Relay Marathon," interpretive signage at Cole Park and Ropes Park, and mobile kiosks to be used at community events such as Earth Day Bay Day, and others. Participants will develop educational information to be used as city utility bill stuffers and website information. "Bay Walk" interpretive signage, a water flow diorama, and other educational materials will be developed. Coordination will be maintained through existing partnerships

## Priority Areas

The priority area for this management measure activity is the City of Corpus Christi, focusing on the CARP watershed.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between CARP stakeholders, governmental partners such as the City of Corpus Christi, Coastal Bend Council of Governments (CBCOG), or others and nongovernmental organizations such as Texas A&M University–Corpus Christi (TAMUCC) or CBBEP, will be beneficial to implement this management measure activity.

## Measurable Milestones

Contingent on receipt of proposed project funding, measurable milestones include:

- creating an introductory public education campaign about water quality in Corpus Christi Bay,
- developing PSAs educating the public on water quality in Corpus Christi Bay,
- developing and introducing an education and awareness program for water quality improvement at Cole Park and Ropes Park,
- the number of public education campaign materials implemented,
- the number of public presentations and community activities implemented, and
- the number of PSAs created and presented to the public.

## Monitoring Component

Implementation progress of this management measure will be tracked by the number of public presentations given, the number of attendees at presentation events, PSAs created, and by conducting surveys to determine the effectiveness of the education

and outreach efforts. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Year 1:**

- Develop and introduce an education and awareness program for water quality improvement at Cole Park and Ropes Park.
- Set public education goals for the next four years.

**Year 2:**

- Create an introductory public education campaign about water quality in Corpus Christi Bay.
- Produce a series of PSAs educating the public on water quality in Corpus Christi Bay.
- Continue Year 1 activities as needed.

**Years 3-5:**

- Implement the introductory public education campaign, PSAs, public presentations, and participation in community activities.
- Where possible, record the number of activities, presentations, participants at events, PSAs, and surveys related to public education campaign efforts.
- Continue Years 1 and 2 activities as needed.
- Provide five-year Management Measure Activity 1.1 progress report.

## Estimated Load Reductions

Load reduction calculations are not applicable to this management measure activity due to this management measure activity only planning implementation for outreach and education events.

**Table 4. Summary of CARP Management Measure Activity 1.1: Promote Watershed Education and Public Awareness in Corpus Christi**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | N/A |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance** | Technical and financial assistance sources would include governmental, academic, and nonprofit entities with programs, grants, and funding that support environmental education for the public. |
| **Educational Component** | Create introductory public education campaign. Work with local media outlets to create a series of PSAs to educate the public about water quality in Corpus Christi. Develop and introduce an education and awareness program to help sponsor existing and new community events aimed at improving water quality. |

| Key Element | Summary |
|---|---|
| **Schedule of Implementation** | • **Year 1:** Develop a community support system for water quality improvement at Cole Park and Ropes Park. Set public education goals.<br>• **Year 2:** Create an introductory public education campaign about water quality in Corpus Christi Bay. Produce a series of PSAs educating the public on water quality in Corpus Christi Bay.<br>• **Years 3-5:** Implement the introductory public education campaign, PSAs, public presentations, and participation in community activities. Record numbers of activities, participants, and surveys, where possible. Provide five-year Management Measure Activity 1.1 progress report. |
| **Interim, Measurable Milestones** | • Number of stakeholders, volunteers, and organizations in the education and awareness program.<br>• Number of PSAs, public presentations, public events and their participants related to the introductory public education campaign. |
| **Monitoring Component** | • **Programmatic**: Implementation progress of this management measure will be tracked by the number of public presentations and PSAs given, the number of attendees at presentation events, and by conducting surveys to determine their effectiveness. Five-year report.<br>• **Environmental:** Implementation progress for this management measure will be tracked through data assessment of the continued water quality monitoring conducted by the TGLO's TBWP. |
| **Responsible Parties** | City of Corpus Christi, CBCOG, CBBEP, Coastal Bend Bays Foundation (CBBF), local environmental groups, TAMUCC, Delmar College, Corpus Christi Independent School District, Surfrider Foundation - Texas Coastal Bend Chapter, Corpus Christi Convention and Visitors' Bureau, Texas State Aquarium, Corpus Christi Caller Times, and other media outlets. |

## Management Measure Activity 1.2. Anti-Littering: "Leave It Better Than You Found It"

The purpose of this management measure activity is to create a specific campaign to reduce littering in the community. The principal focus will be to reduce and discourage littering from vehicles, as well as from individuals around restaurants, shopping areas, parks, beaches, and all other public use spaces. Although anti-littering activities would not directly remove bacteria within the watershed, they could help prevent bacteria introduction through public education on environmental issues and increased community ownership for a clean and healthy city.

## Educational Component

The educational component of this management measure activity will include adopting and implementing educational programs designed for all age groups that target anti-littering and environmental awareness and developing support and participation from local businesses and residents in community outreach programs, including the "Leave It Better Than You Found It" campaign.

## Priority Areas

The priority area for this management measure activity is the City of Corpus Christi, focusing on the CARP watershed.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between CARP stakeholders, governmental partners such as the City of Corpus Christi, TGLO, CBCOG, or others and nongovernmental organizations such as CBBF or CBBEP, will be beneficial to implement this management measure activity.

## Measurable Milestones

Contingent on receipt of proposed project funding, measurable milestones include:

- creating an introductory anti-littering public education campaign focused on reducing littering in and around Corpus Christi Bay, especially the CARP watershed,
- producing a series of PSAs educating the public on reducing littering in and around Corpus Christi Bay,
- developing a local anti-littering and litter cleanup program (trash clean ups such as "Texas Adopt a Beach") around Corpus Christi Bay, especially at Cole Park and Ropes Park,
- the number of public education campaign materials implemented,
- the number of public presentations and community activities, and
- the number of PSAs created and presented to the public.

## Monitoring Component

Implementation progress of this management measure will be tracked by the number of campaigns conducted, number of events related to reducing litter such as clean-up events and the number of participants, public presentations, PSAs, and by conducting surveys to determine the effectiveness and public opinion of public education and outreach efforts. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Year 1:**

- Develop a local anti-littering and litter cleanup program for reducing litter at Cole Park and Ropes Park.
- Set public education and campaign goals for the next four years.

**Year 2:**

- Implement campaigns such as "Leave It Better Than You Found It," and other anti-littering campaigns that target reducing littering around Corpus Christi Bay.
- Produce a series of PSAs educating the public on litter reduction.
- Continue Year 1 activities, as needed.

**Year 3-5:**

- Continue anti-littering campaigns, PSAs, public presentations and participation in community activities.
- Record numbers of activities, participants, and surveys, where possible.
- Continue Years 1 and 2 activities, as needed.
- Provide five-year Management Measure Activity 1.2 progress report.

# Estimated Load Reductions

Load reduction calculations are not applicable to this management measure due to this management measure activity only planning implementation for outreach and education events.

**Table 5. Summary of CARP Management Measure Activity 1.2: Anti-Littering: "Leave It Better Than You Found It"**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | N/A |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance** | Technical and financial assistance sources would include government, academic, and nonprofit entities with programs, grants, and funding that support environmental education, including anti-littering, for the public. |
| **Educational Component** | Adopt and implement educational programs designed for all age groups that target anti-littering and environmental awareness. Develop support and participation from local businesses and residents in community outreach programs, including the "Leave It Better Than You Found It" campaign. |
| **Schedule of Implementation** | • **Year 1:** Develop a local program for reducing litter at Cole Park and Ropes Park. Set public education and campaign goals.<br>• **Year 2:** Implement "Leave It Better Than You Found It," and other anti-littering campaigns about reducing littering around Corpus Christi Bay. Produce a series of PSAs educating the public on litter reduction.<br>• **Years 3-5:** Continue anti-littering campaigns, PSAs, public presentations, and participation in community activities. Record numbers of activities, participants, and surveys, where possible. Provide five-year Management Measure Activity 1.2 progress report. |
| **Interim, Measurable Milestones** | • Develop and maintain the local anti-littering program.<br>• Create and implement an anti-littering public education campaign.<br>• Number of campaign events, PSAs, public presentations and events, and the number of attendees at events related to anti-littering. |
| **Monitoring Component** | • **Programmatic:** Implementation progress will be tracked by recording the number of campaigns conducted, number of events and participants at these events, public presentations given, PSAs, and by conducting surveys to determine the effectiveness and public opinion of these anti-littering education and outreach efforts. Five-year report.<br>• **Environmental:** Implementation progress for this management measure will be tracked through data assessment of the continued water quality monitoring conducted by the TGLO TBWP. |
| **Responsible Parties** | City of Corpus Christi, TGLO, CBCOG, Corpus Christi Convention and Visitors' Bureau, CBBF, CBBEP, local media outlets, and other appropriate entities such as schools. |

## Management Measure Activity 1.3. Pet Waste Disposal

The purpose of this management measure activity is to reduce loading from domestic pet waste by establishing coordination with key stakeholders to facilitate the reduction and eventual elimination of improper pet waste disposal.

## Educational Component

The goal of this management measure is to improve community understanding of water quality problems caused by improper disposal of pet waste. This management measure seeks to develop an adopt-a-pet waste station program and distribute educational materials and pet waste disposal kits to pet associated businesses and service providers and collaborate with the City of Corpus Christi to educate pet owners on proper pet waste management at the city's "Doggie Pool Day" event.

This management measure also includes the creation of PSAs for proper pet waste disposal to engage pet owners and encourage them to properly dispose of their pet's waste. Professional expertise will be needed to produce short, engaging videos which capture the importance of proper pet waste disposal and its impact on water quality. To be widely viewed, the videos will be provided to area TV stations, shown at meetings and talks, and provided to different departments within the City of Corpus Christi, such as the city's Health Department.

## Priority Areas

Specific locations within the CARP watershed with high pet traffic will be identified and prioritized for pet waste disposal station placement.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between the City of Corpus Christi Parks and Recreation Department, CARP stakeholders, local animal related businesses, veterinary clinics, animal rescue/adoption centers, and media outlets will be beneficial to implement this management measure activity.

## Measurable Milestones

Contingent on receipt of proposed project funding, measurable milestones include:

- tracking the number of stakeholders participating in the developed pet waste reduction program,
- developing a pet waste reduction program,
- the number of educational materials and pet waste disposal kits distributed to businesses and services,
- the number of existing pet waste stations maintained per year,
- the number of new pet waste station installations in the CARP watershed,
- the numbers of campaign events, PSAs, public presentations, public events attended, and numbers of individuals attending events, and
- pet waste collection data from community participants.

## Monitoring Component

Implementation progress of this management measure will be tracked by the number of pet waste stations installed, community partners distributing pet waste disposal kits, campaign events, public presentations and PSAs, the number of attendees at events, and by conducting surveys to determine effectiveness. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Year 1:**

- Develop and introduce a pet waste reduction program (funding, volunteers, and partnerships with local organizations) for reducing improper pet waste disposal at Cole Park and Ropes Park.
- Seek and secure funding.
- Set public education and campaign goals for the next four years.

**Year 2:**

- Implement pet waste stations program, pet waste disposal education campaigns, “Adopt-a-Pet Waste Station” program and obtain pet waste disposal materials.
- Produce a series of PSAs about reducing improper pet waste disposal around Corpus Christi Bay.
- Distribute pet waste disposal kits to pet-associated businesses and service providers.
- Continue Year 1 activities, as needed.

**Years 3-5:**

- Continue to implement pet waste stations program, pet waste disposal education campaigns, “Adopt-a-Pet Waste Station” program and obtain pet waste disposal materials.
- Continue to distribute PSAs about reducing improper pet waste around Corpus Christi Bay
- Distribute pet waste disposal kits to pet-associated businesses and service provides.
- Attend community events.
- Collect pet waste collection data from community participants.
- Continue Year 1 activities, as needed.
- Provide five-year Management Measure Activity 1.3 progress report.

## Estimated Load Reductions

Reducing pet waste through community education and the installation of pet waste stations could potentially lead to load reductions in the CARP watershed. Potential load reduction calculations are based on the waste of all 9,052 dogs in the CARP watershed (TCEQ, 2021, AVMA, 2012). If this management measure is 40% effective, 63,436.42 billion cfu of Enterococci could be removed from the watershed per year.

$Load_{pw} = N_{pw}$ x Load Rate x $E_{pw}$ x 365 days/year

Where:

$Load_{pw}$ = estimated load reduction from picking up pet waste, 63,436.42 billion cfu/year.

$N_{pw}$ = 3,621 the number of dogs that waste could be removed from per year (TCEQ, 2015a).

Load Rate = 15%, percent of dog pet waste that reaches the water body (Hyer & Moyer, 2004)

$E_{pw}$ = .32 billion cfu/day Enterococci produced per dog (Wright et al. 2009).

**Table 6. Summary of CARP Management Measure Activity 1.3: Pet Waste Disposal**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | Improper disposal of pet waste |
| **Potential Load Reduction** | 63,436.42 billion cfu per year of Enterococci |
| **Technical and Financial Assistance** | Technical and financial assistance sources would include governmental (federal, state and local agencies), and academic and nonprofit entities with programs that support pet waste disposal, provide public education on the effects of improper pet waste disposal on water quality and offer educational materials for the public. |
| **Educational Component** | Providing education and outreach to community residents regarding proper disposal of pet waste. This will be accomplished through creating PSAs, developing an Adopt-a-Pet waste station program, and distributing educational materials and pet waste disposal kits to pet associated businesses and service providers. Expertise will be required to produce videos capturing the importance of pet waste disposal and its impact on water quality. The video will be broadcast on local TV stations and at other relevant meetings and events. |
| **Schedule of Implementation** | • **Year 1:** Develop and introduce a pet waste reduction program for reducing improper pet waste disposal at Cole Park and Ropes Park. Seek and secure funding. Set public education and campaign goals.<br>• **Year 2:** Implement pet waste stations program, pet waste disposal education campaigns and obtain pet waste disposal materials. Produce a series of PSAs about reducing improper pet waste around Corpus Christi Bay. Distribute pet waste disposal kits.<br>• **Years 3-5:** Continue pet waste stations program, pet waste disposal education campaigns and pet waste disposal materials. Continue to distribute PSAs about reducing improper pet waste around Corpus Christi Bay. Distribute pet waste disposal kits. Attend community events. Provide five-year Management Measure Activity 1.3 progress report. |

| | |
|---|---|
| **Interim, Measurable Milestones** | • track the numbers of stakeholders participating in the pet waste reduction program list/group.<br>• Track the numbers of stakeholders participating in the pet waste reduction program list/group.<br>• Develop a pet waste reduction program.<br>• Number of new pet waste station installations.<br>• Number of existing pet waste stations maintained per year.<br>• Number of campaign events, PSAs, public presentations, public events attended, and numbers of individuals attending events. Compile pet waste collection data from community participants. |
| **Monitoring Component** | • **Programmatic:** Implementation progress of this management measure will be tracked by the number of pet waste stations installed, community partners helping to distribute pet waste disposal kits, campaign events, public presentations and PSAs, the number of attendees at events, and by conducting surveys to determine their effectiveness. Five-year report.<br>• **Environmental:** Implementation progress for this management measure will be tracked through data assessment of the continued water quality monitoring conducted by the TGLO TBWP. |
| **Responsible Parties** | City of Corpus Christi, local animal-related businesses, local veterinarian clinics and animal rescue/adoption centers, City of Corpus Christi Parks and Recreation, and local media outlets. |

## Management Measure Activity 1.4. Prevent Intentional Dumping and Disposal

The goal of this management measure activity is to increase awareness of illegal dumping and disposal and the harm they cause to the environment and economy through an extensive awareness campaign. Illegal dumping negatively impacts watersheds and creates unhealthy and unsafe conditions for people that work, live, or recreate in impacted areas. Establishing coordination with key stakeholders to help develop education and outreach programs will facilitate the reduction of improper waste disposal and dumping in and around the CARP watershed.

## Education Component

With commercial business support, this management measure activity will establish an education and outreach campaign, “Prevent Intentional Dumping and Disposal”, and other programs targeted towards community involvement. This campaign will include outreach activities, such as the creation of an info booth for local events. These programs will seek to identify and report instances of illegal dumping and disposal. This management measure activity will also seek to promote and encourage applicable stakeholders to attend training workshops provided by the Texas Illegal Dumping Resource Center (TIDRC) on illegal dumping regulations, and methods to address these issues.

## Priority Area

The priority area for this management measure activity is the City of Corpus Christi, focusing on the CARP watershed.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between the City of Copus Christi, CARP stakeholders, CBBF, and other local stakeholders such as TAMUCC, Delmar College, Corpus Christi Independent School District, Surfrider Foundation - Texas Coastal Bend Chapter, Corpus Christi Convention and Visitors' Bureau, Texas State Aquarium, Corpus Christi Caller Times, media outlets, and TIDRC, will be beneficial to implementing this management measure activity.

## Measurable Milestones

Contingent on receipt of proposed project funding, measurable milestones include:

- establishing education and outreach programs focused on reducing illegal dumping in and around the City of Corpus Christi with a focus in the CARP watershed,
- producing a series of PSAs educating the public on illegal intentional dumping in and around the City of Corpus Christi,
- number of campaign materials used, public presentations given, community activities completed related to illegal dumping, and the number of PSAs created and presented to the public,
- the number of attendees at education and outreach events related to illegal dumping, and at TIDRC events,
- the number of education and outreach events conducted related to illegal dumping, and
- number of meetings stakeholders attend with solid waste advisory committees associated with the city coordination committee, Nueces County, and nonprofit organizations.

## Monitoring Component

Implementation progress of this management measure will be tracked by recording the number of campaigns conducted, public events and presentations, PSAs, attendees at cleanup events, and by conducting surveys to determine the effectiveness and public opinion of this management measure. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

### Year 1:

- Develop an education and outreach program for the campaign,
- Set public education and campaign goals for the next four years.

### Year 2:

- Implement "Prevent Intentional Dumping and Disposal" campaign targeting the City of Corpus Christi, with a focus on the areas in and around CARP.
- Produce a series of PSAs.

- Continue Year 1 activities, as needed.

**Years 3-5:**

- Continue illegal dumping campaigns, PSAs, public presentations and participation in community activities.
- Record numbers of public outreach activities, participants, and surveys, where possible.
- Continue Years 1 activities, as needed.
- Provide five-year Management Measure Activity 1.4 progress report.

# Estimated Load Reductions

CBCOG has partnered with the CBBEP on the Up2U+ project. Since 2022 the project has collected 1,111 tires and 78.83 tons of other materials, which could have been dumped within the Oso Creek/Bay and Cole, Ropes Parks watersheds. A Tres Palacios study found a correlation between the cleanup of dumping sites and bacterial load reductions in the watershed, of up to 65% (EPA, 2012). This finding suggests that a combination of education and cleanup of dumping sites can be an effective implementation method to reduce bacteria in watersheds. However, an estimated load reduction was not calculated at this time since no clean up events are planned for this management measure activity.

**Table 7. Summary of CARP Management Measure Activity 1.4: Prevent Intentional Dumping and Disposal**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | Intentional illegal dumping and disposal |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance Needed** | Technical and financial assistance sources include federal, state, and local governmental agencies (EPA, NPS, TGLO, TCEQ, TIDRC, TxDOT, CBCOG, City of Corpus Christi), and nonprofit entities (CBBEP, CBBF) that provide programs and funding for identifying, reporting, and reducing illegal dumping. |
| **Education Component** | Establish education and outreach campaign targeted towards community involvement. Create an info booth for local events. Facilitate training and workshops provided by TIDRC on illegal dumping regulations. |
| **Schedule of Implementation** | • **Year 1**: Develop an education and outreach program for the campaign, set public education and campaign goals.<br>• **Year 2**: Implement "Prevent Intentional Dumping and Disposal" campaign targeting areas around Corpus Christi Bay, especially the CARP watershed. Produce a series of PSAs and continue Year 1 activities as needed.<br>• **Years 3-5**: Continue illegal dumping campaigns, PSAs, public presentations and participation in community activities. Record numbers of activities, participants, and surveys, as possible. Provide five-year Management Measure Activity 1.4 progress report. |
| **Interim, Measurable Milestones** | • Establish education and outreach programs focused on reducing illegal dumping in and around the City of Corpus Christi with a focus in the CARP watershed. |

| | |
|---|---|
| | • Produce a series of PSAs educating the public on illegal intentional dumping in and around the City of Corpus Christi.<br>• The number of campaign materials implemented, public presentations given, and community activities completed, and number of PSAs created and presented to the public.<br>• Attendance at education and outreach events, and at TIDRC events.<br>• Number of meetings stakeholders attend with solid waste advisory boards and committees. |
| **Monitoring Component** | • **Programmatic:** Track number of campaigns conducted, public events and presentations, PSAs given, and number of attendees at cleanup events. Conduct surveys to determine management measure effectiveness and public opinion. Five-year report.<br>• **Environmental:** Implementation progress for this management measure will be tracked through data assessment of the continued water quality monitoring conducted by the TGLO TBWP. |
| **Responsible Parties** | City of Corpus Christi, CBBF, and local environmental groups with support from educational institutions (TAMUCC, Delmar College, Corpus Christi Independent School District), Surfrider Foundation - Texas Coastal Bend Chapter, Corpus Christi Convention and Visitors' Bureau, Texas State Aquarium, Corpus Christi Caller Times, media outlets, and TIDRC. |

## Management Measure Activity 1.5. Slow the Flow (Low Impact Development) Initiative

The purpose of this management measure activity is to educate and promote low impact development (LID) to improve water quality, through a "Slow the Flow" initiative in and around the CARP watershed. "Slow the Flow" focuses on slowing the movement of water in a watershed to reduce NPS pollution.

## Education Component

The educational component of this management measure activity will provide "Slow the Flow" training workshops, conducted by Texas A&M AgriLife Extension Service (AgriLife Extension), , and others as available, targeted at local building associations, engineering firms, architect and landscape design groups, and other design community members to demonstrate LID techniques and their benefits. This management measure activity will also promote LID on commercial and residential properties by demonstrating the benefits through social media and educational presentations targeting the public. Where feasibility and funding allow, this management measure activity also seeks to incorporate LID techniques into City of Corpus Christi projects as demonstration projects.

## Priority Areas

The priority area for this management measure activity is the City of Corpus Christi, focusing in and around the CARP watershed.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between the City of Corpus Christi, CBXOG, CARP stakeholders, and other professional organizations, such as such as AIA, builders' associations, non-profit groups, academic and governmental organizations, local

gardening/landscaping centers and gardeners' community organizations, and media outlets, will be beneficial to implement this management measure activity.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones include:

- providing "Slow the Flow" training workshops to the design community demonstrating LID techniques and benefits,
- promoting LID with demonstration projects on individual and city properties, and
- promoting LID benefits through social media and educational presentations.
-

## Monitoring Component

The implementation progress of this management measure activity will be tracked through the number of workshops and promotions given, the number of attendees at workshops, and by conducting surveys with workshop participants about event effectiveness. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Year 1:**

- Develop a "Slow the Flow" and LID program.
- Set public education and campaign goals for the next four years.

**Year 2:**

- Implement "Slow the Flow" initiative and other LID workshops around Corpus Christi Bay for local designers and engineers.
- Produce a series of PSAs regarding LID.
- Use social media sites to promote campaign.
- Continue Year 1 activities, as needed.

**Years 3-5:**

- Continue LID workshops for the target audiences.
- Continue to produce PSAs regarding LID.
- Encourage groups that use LID, such as the Texas Land/Water Sustainability Forum, to create workshops for the design community using existing materials, such as those provided by the Lady Bird Johnson Wildflower Center.
- Record numbers of activities, participants, and surveys.
- Continue Years 1 & 2 activities, as needed.
- Provide five-year Management Measure Activity 1.5 progress report.

## Estimated Load Reductions

Implementation of the "Slow the Flow" initiative, through community education and workshops for the design community, could lead to load reductions in the watershed. According to existing studies on how LID affects bacterial load reductions, LID implementation has an average bacteria log reduction for Enterococci of 0.73 (Rippy, 2015). No load reductions were estimated at this time due to this management measure activity only implementing outreach and education events.

**Table 8. Summary of CARP Management Measure Activity 1.5: Slow the Flow (LID) Initiative**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | Stormwater runoff |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance Needed** | Financial and technical assistance sources include federal, state, and local governmental agencies (EPA, TCEQ, City of Corpus Christi, CBCOG), academic institutions, and nonprofit organizations (CBBEP, AIA) and other entities with programs and/or funding to implement LID and "Slow the Flow" programs. |
| **Education Component** | Provide "Slow the Flow" training workshops to the design community demonstrating LID techniques and benefits. Promote LID with demonstration projects on individual and city properties Promote LID benefits through social media and educational presentations. |
| **Schedule of Implementation** | • **Year 1:** Develop a "Slow the Flow" and LID program. Set public education and campaign goals.<br>• **Year 2:** Implement "Slow the Flow" and other LID workshops around Corpus Christi Bay for local designers and engineers. Produce a series of PSAs regarding LID. Use social media sites to promote campaign.<br>• **Years 3-5:** Continue LID workshops for the target audiences. Use existing materials to promote LID and create workshops for the design community. Record numbers of activities, participants, and surveys. |
| **Interim, Measurable Milestones** | • Solicit feedback from LID workshop participants.<br>• Number of training workshops to promote LID, number of participants, and attendee's survey responses. |
| **Monitoring Component** | • **Programmatic:** Track workshops and promotions given, the number of attendees at workshops, and conduct surveys on workshop and event effectiveness. Five-year report.<br>• **Environmental:** Implementation progress for this management measure will be tracked through data assessment of the continued water quality monitoring conducted by the TGLO TBWP. |
| **Responsible Parties** | Various professional, non-profit, academic and government organizations, local gardening/landscaping centers and gardeners' community organizations, and media outlets. |

## Management Measure Activity 1.6. Install Additional Signage to Alert the Public of Potential Health Risks at Cole Park and Ropes Park After Rain Events

The purpose of this management measure activity is to reduce public health risks associated with recreational use of bay waters adjacent to city stormwater outfalls

which have elevated bacteria levels during and immediately following heavy rain events.

Until solutions to the elevated bacterial levels have been implemented for Cole Park and Ropes Park, additional signage should be added to the CARP watershed. These signs should include information about the potential public health risks associated with contact recreation in bay waters when bacteria levels exceed state water quality standards.

## Education Component

Education for this management measure activity will be focused on installing additional signage of potential health risks associated with recreating at public beaches when bacteria levels exceed water quality standards. Surveys will also be distributed to the public to determine the effectiveness of the signage.

## Priority Areas

Priority areas for this management measure activity will be public access points in Cole and Ropes Parks and other public areas in the CARP watershed, which are used to access bay waters for contact recreation.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. The City of Corpus Christi, CARP stakeholders, and other local stakeholders, could provide signage. If a stakeholder besides the city, provides signage, they should coordinate with the city on the content, design, and installation at public parks.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones include:

- proposing additional signage to the City of Corpus Christi for approval, and
- installing permanent signs advising the public of general risks of using bay waters for contact recreation during and immediately after heavy rain events, and
- the number of surveys distributed on sign usage within Cole Park and Ropes Park.

## Monitoring Component

The programmatic implementation progress for this management measure activity will be monitored by the number of signs installed and maintained in CARP.

## Implementation Schedule

**Year 1:**

- Propose permanent signage be installed at Cole Park and Ropes Park and its adjoining public spaces and parks to the City of Corpus Christi for approval.

**Year 2-5:**

- Install and maintain permanent signage within the priority areas.
- Distribute surveys to the public to determine the effectiveness of the signage and track responses.
- Provide five-year Management Measure 1.6 progress report.

## Estimated Load Reductions

Load reduction calculations were not calculated for this management measure activity due to this management measure activity only planning implementation for outreach and education events.

**Table 9. Summary of CARP Management Measure Activity 1.6: Install Additional Signage to Alert the Public of Potential Health Risks at Cole Park and Ropes Park After Rain Events**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | N/A |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance Needed** | Technical and financial assistance sources would include governmental, academic, and nonprofit entities with programs and funding supporting public health and environmental education. |
| **Education Component** | Educate the public of health risks via signage. |
| **Schedule of Implementation** | • **Year 1:** Propose City of Corpus Christi approve permanent signage warning health risks to recreational users of bay waters following rain events.<br>• **Years 2-5:** Install and maintain permanent signage at access points in CARP. Track the number of surveys distributed on sign usage. Provide five-year Management Measure Activity 1.6 progress report. |
| **Interim, Measurable Milestones** | • Propose additional signage to the City of Corpus Christi for approval.<br>• Number of permanent signs installed advising the public of health risks of contact recreation during and immediately after rain events.<br>• Number of surveys distributed on sign usage within Cole and Ropes Park. |
| **Monitoring Component** | **Programmatic:** Implementation progress for this management measure will be tracked by the number of signs installed and maintained. Five-year report. |
| **Responsible Parties** | City of Corpus Christi, CARP stakeholders, and other local stakeholders, if applicable |

# Management Measure 2.0: Monitoring

To assess progress towards reducing bacterial loading in the CARP watershed, an evaluation of monitoring data will be needed on a regular basis. Monitoring and annual

evaluation will determine the effectiveness of this I-Plan, and if any of its activities are leading to improvements in water quality, if time frame adjustments are needed, or if a revision is required, a more in-depth evaluation will be completed every five years, as resources are available and with stakeholder participation.

The TMDLs developed for CARP suggest that the main source of bacteria loading is MS4 runoff. MS4 runoff can be attributed to (1) stormwater flowing into the stormwater collection system and through the pipes into Corpus Christi Bay, (2) surface runoff from the land that flows directly into Corpus Christi Bay, or (3) a combination of both (TMDL, 2021).

The Monitoring and Research workgroup recommended three initial activities for this I-Plan management measure:

2.1) *Continue Sampling Enterococci Levels at Cole Park and Ropes Park.*

2.2) *Collect Rainfall Data Near Cole Park and Ropes Park.*

2.3) *Conduct Stormwater Outfall Flow Sampling.*

These monitoring measures will form the basis for potential research projects to better understand the causes, sources, and potential solutions to high bacteria levels in the CARP watershed. Conclusions derived from post-implementation water quality monitoring will be an important indicator of whether implementation activities are resulting in the desired reduction of bacteria loading. The results of this research will provide essential information to determine strategic modifications to management measures outlined in this plan.

## Technical Assistance for Management Measure 2.0

Technical assistance sources for Management Measure 2.0 include governmental, academic, and nonprofit entities with programs that support environmental education for the public, like those entities listed as Responsible Parties in each management measure activity.

## Financial Assistance for Management Measure 2.0

Financial assistance to implement the Management Measure 2.0 may come from federal (EPA), state (TCEQ), and local governmental (City of Corpus Christi) and nonprofit entities. These programs include:

- **CWA Section 319(h) Grants:** EPA provides grant funding to Texas to implement the state's approved NPS Management Program and is administered by TCEQ and TSSWCB. The EPA-approved Texas program provides the framework for determining which activities are eligible for funding under CWA Section 319(h). In general, these activities include non-regulatory programs and are related to controlling NPS pollution. EPA-approved NPS programs cover costs associated with technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of specific NPS projects. (EPA, 2022)

- **Coastal Bend Community Foundation Grants**: Donors in the Coastal Bend, through both current and testamentary gifts, have enabled the Foundation to enhance and improve the quality of life through grants to area nonprofit organizations. The Foundation's grants from unrestricted funds cover a broad spectrum of projects, from the Arts to Zoology.
- C**oastal Bend and Bays Estuaries Program**: The CBBEP is a non-regulatory, partnership-led effort working with industry, environmental groups, bay users, local governments and resource managers to protect and restore the health and productivity of the region's bays and estuaries.

## Management Measure Activity 2.1. Continue Sampling Enterococci Levels at Cole Park and Ropes Park

The purpose of this management measure activity is to collect water quality data in the impaired AUs to determine if TCEQ water quality standards are being met and to notify the public of water quality. The current program conducting sampling is the TBWP, administered by TGLO and funded through EPA. EPA awards grants under authority of the Beaches Environmental Assessment and Coastal Health Act (BEACH Act) to states to develop and implement programs to monitor beaches and notify the public when it is not safe to swim.

Water samples are collected weekly during the beach season (March through October) and biweekly during the off-season (November through February). Samples at Cole Park and Ropes Park are currently being collected on Wednesdays.

This management measure activity involves the continued collection and testing of water quality samples for the presence of indicator bacteria Enterococci, compared to the BAV 104 cfu/100 ml. If sample results exceed the BAV, TGLO will notify local government representatives immediately and the required signs warning of elevated bacteria levels will be posted at the affected beaches.

In addition, bacteria levels for each sample are posted in real time on the TBWP public website[6]. Although there have been news articles released notifying the public of TBWP's website, many beach goers still might not be aware of this very important tool they can use to avoid beach activities during high bacteria events and reduce their exposure to harmful bacteria.

## Education Component

The goal of the education component is to provide the public with information about water quality at recreational beaches to promote public health and safety. This management measure plans to utilize public outreach activities such as social media, flyers and information booths, for an education and outreach campaign. This campaign will focus on educating the public on how they can avoid contact with harmful bacteria using the TBWP's website.

[6] www.TexasBeachWatch.com

## Priority Areas

The priority area for this management measure activity is the CARP watershed.

## Responsible Parties and Funding

Each organization listed will be responsible only for expenses associated with its own efforts: TGLO, TAMU-CC, EPA, CBBEP, Corpus Christi-Nueces County Public Health District (CCNCPHD) (along with other NELAP labs) and the City of Corpus Christi.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- the number of samples collected and dissemination of results, and
- the number of education and outreach activities completed.

## Monitoring Component

The environmental monitoring component for this management measure will consist of the continuation of water quality monitoring at Cole Park and Ropes Park. The programmatic monitoring component for this management measure will consist of tracking the number of social media posts generated, the number of flyers and number of events that an information booth was present to educate the public on TBWP's website. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Year 1:**

- Continue current TBWP sampling.
- Develop a public education and outreach campaign to promote safe beach recreation.

**Years 2-5:**

- Continue current TBWP sampling.
- Implement the public education and outreach campaign to provide the public with information about water quality at recreational beaches to promote public health safety.
- Provide five-year Management Measure Activity 2.1 progress report.

## Estimated Load Reductions

No direct reduction will come from monitoring, but additional data and information collected may be useful in mitigating bacteria loads.

**Table 10. Summary of CARP Management Measure Activity 2.1: Continue Sampling Enterococci Levels at Cole Park and Ropes Park**

| Key Element | Summary |
|---|---|

| | |
|---|---|
| **Causes and Sources** | N/A |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance Needed** | Sources of financial assistance may be local citizen groups and nonprofit organizations, EPA, CBBEP, the City of Corpus Christi. The current EPA grant is administered by the CCNCPHD laboratory |
| **Education Component** | Provide the public with information about water quality at recreational beaches to promote public health safety. |
| **Schedule of Implementation** | • **Year 1**: Continue current TBWP sampling. Develop a public education and outreach campaign to promote safe beach recreation.<br>• **Years 2-5:** Continue current TBWP sampling. Implement the public outreach and education campaign to provide the public with information about water quality at recreational beaches to promote public health safety. Provide five-year Management Measure 2.1 progress report. |
| **Interim, Measurable Milestones** | • Number of samples collected and dissemination of results.<br>• Number of education and outreach activities completed. |
| **Monitoring Component** | • **Programmatic:** Conduct educational outreach activities informing public of beach water quality. Five-year report.<br>• **Environmental:** Implementation progress for this management measure will be tracked through data assessment of the continued water quality monitoring conducted by the TGLO's TBWP. |
| **Responsible Parties** | TGLO, CCNCPHD, and the City of Corpus Christi. |

## Management Measure Activity 2.2. Collect Rainfall Data Near Cole Park and Ropes Parks

The purpose of this management measure activity is to collect rainfall data within the CARP watershed and near stormwater outfalls. Developing a long-term time series of rainfall information near Cole Park and Ropes Park may provide a better understanding of the relationship between stormwater flows caused by rainfall events and bacteria exceedances at these impaired AUs. Data should be made available for use by researchers to correlate precipitation amounts with stormwater discharge and Enterococci levels, as well as to determine the effect of varying amounts of rainfall on bacteria amounts in the bay. Methods of rainfall data collection could include Doppler radar data analysis, conventional rain gauges, and weather stations.

To complete the implementation for this management measure, the CARP Coordination Committee envisions a cooperative effort including the City of Corpus Christi, local universities, residents, and local research and data collection organizations. Specific proposals should be developed by entities listed in the "Responsible Parties" section below, or others, as appropriate.

## Education Component

The educational component of this management measure activity includes creating PSAs and public outreach education materials to inform the public about opportunities to participate in citizen data collection.

## Priority Areas

The priority areas for this management measure activity will be the Louisiana Avenue and Brawner Parkway drainage systems. Real-time rain gauges should be installed at residences located along these drainage systems.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between the City of Corpus Christi, EPA, CARP stakeholders, local universities (TAMUCC), residents, and local research and data collection organizations, such as CBBEP, will be beneficial to implement this management measure activity.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones include:

- collecting rainfall data near Cole Park and Ropes Park,
- developing and implementing a rainfall data collection program in a smaller pilot project area,
- developing and implementing a rainfall data collection program in expanded areas within the CARP watershed, and
- number of samples collected and dissemination of results, and
- developing a database to track rainfall and bacteria data.

## Monitoring Component

The implementation progress for this management measure will be tracked by the number of PSAs and public outreach education material sent out and through the collection of accurate rainfall data near stormwater outfalls and drainage systems. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Year 1:**

- Reach out to homeowners about installing gauges and/or weather stations on their property.
- Solicit project proposals from responsible parties.
- Plan and implement a rainfall data collection program in a smaller pilot project area.
- Collect rainfall data near Cole Park and Ropes Park.

**Years 2-5:**

- Plan and implement a rainfall collection program within the CARP watershed.
- Continue data collection, management and maintenance.

- Collect stormwater outfall flow samples.
- Develop a database to track rainfall and bacteria data.
- Provide five-year Management Measure Activity 2.2 progress report.

## Estimated Load Reductions

No direct load reductions will come from monitoring, but the additional data and information collected through this management measure will be useful in helping to mitigate bacteria loads in the CARP watershed.

**Table 11. Summary of CARP Management Measure Activity 2.2: Collect Rainfall Data Near Cole Park and Ropes Park**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | N/A |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance Needed** | Will vary depending on data collection methods, funding sources, and responsible parties, but may include TAMUCC, local nonprofit organizations such as CBBEP and governmental entities like EPA and the City of Corpus Christi. |
| **Education Component** | PSAs and public outreach education material on citizen data collection. |
| **Schedule of Implementation** | • **Year 1:** Reach out to homeowners about installing gauges and/or weather stations on their property. Solicit project proposals from responsible parties. Plan and implement a rainfall data collection program in a smaller pilot project area. Collect rainfall data near Cole Park and Ropes Park.<br>• **Years 2-5:** Plan and implement a rainfall collection program within the CARP watershed. Continue data collection, management and maintenance. Collect stormwater outfall flow samples. Develop a database to track rainfall and bacteria data. Provide five-year Management Measure 2.2 progress report. |
| **Interim, Measurable Milestones** | • Develop a database to track rainfall and bacteria data.<br>• Collect rainfall data near Cole Park and Ropes Park.<br>• Develop and implement a rainfall data collection program in a smaller pilot project area.<br>• Develop and implement a rainfall data collection program.<br>• Number of samples collected and dissemination of results. |
| **Monitoring Component** | • **Programmatic:** Tracking the number of PSAs and public outreach education material sent out. Five-year report.<br>• **Environmental:** Collect rainfall data in close proximity to stormwater outfalls and drainage systems. |
| **Responsible Parties** | CARP Coordination Committee envisions a cooperative effort including the City of Corpus Christi, local universities, residents, and local research and data collection organizations. |

## Management Measure Activity 2.3. Conduct Stormwater Outfall Flow Sampling

The purpose of this management measure activity is to conduct stormwater outfall flow sampling to better correlate the flows with bacteria levels in Corpus Christi Bay, which may give stakeholders more information to assist the City of Corpus Christi in developing timely public safety notifications regarding water quality. Additionally,

along with rainfall data collected as a part of Management Measure Activity 2.2, stormwater flow data may be useful to better understand causes and sources of high bacteria levels at Cole Park and Ropes Park beaches, and for implementing strategies to ultimately prevent further water quality degradation. Data collected may also be used to help measure success of other management measures proposed in the I-Plan.

The goal is to collect stormwater flow data in order to correlate stormwater outfall flow with Enterococcus data collected through the TBWP to see if there are any significant relationships. Ultimately, if a correlation is found, flow in the stormwater system could be used as a proxy for alerting the public when to avoid the impaired AUs.

Methods of data collection could include in-pipe laser flow meters, Parshall Flumes, automated water flow meters, and other flow data collection technology. Some equipment for this purpose could be borrowed from CCS at no cost. The influence of flow within the stormwater system should be considered regardless of method of flow data collection. Detailed models of the effect of tides on water levels through Corpus Christi Bay are available and should be used in conjunction with stormwater flow data to determine non-tidal flow within the system.

## Education Component

If a correlation between Enterococcus and stormwater at outfall pipes is found through sampling and analysis, then the development of an alert system to notify the public when bacteria levels are high may be established.

## Priority Areas

A pilot project would be installed within a smaller subwatershed, and then expanded to the Louisiana Avenue and Brawner Parkway stormwater drainage channels and outfalls.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. The CARP Coordination Committee envisions a cooperative effort including the City of Corpus Christi, local universities, residents, and local research and data collection organizations such as CCS, CBBEP, etc.

## Measurable Milestones

Contingent on receipt of proposed project funding, measurable milestones include:

- planning and implementing a stormwater outfall sampling pilot project within a subwatershed of the impaired AUs, and
- planning and implementing a stormwater outfall sampling project for the entire CARP watershed.

## Monitoring Component

Programmatic monitoring of this management measure activity will consist of tracking the collection of stormwater flow data within the CARP watershed, with an eventual focus on the Louisiana Avenue and Brawner Parkway stormwater drainage systems. Data collection and analysis should continue through the life of this I-Plan and progress will be monitored through the study completion and results. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

### Year 1:

- Plan and implement a stormwater outfall flow sampling pilot project within a subwatershed.

### Years 2-5:

- Complete an evaluation and analysis of the pilot project and its potential application within the entire CARP watershed.
- Based on the evaluation of pilot project data, a project may be implemented for the entire CARP watershed, with a focus on the Louisiana Avenue and Brawner Parkway stormwater drainage systems. Data collection for this larger project should continue throughout the life of this I-Plan.
- Provide five-year Management Measure 2.3 Activity progress report.

## Estimated Load Reductions

No direct reduction will come from monitoring, but additional data and information will be useful in mitigating bacteria loads.

**Table 12. Summary of CARP Management Measure Activity 2.3: Conduct Stormwater Outfall Flow Sampling**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | N/A |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance Needed** | Will vary depending on data collection methods, funding sources, and responsible parties but may include TAMUCC local nonprofit organizations (CBBEP), EPA, and the City of Corpus Christi. |
| **Education Component** | Use data from stormwater and bacteria samples to alert the public when bacteria levels may be high at the impaired AUs. |
| **Schedule of Implementation** | • **Year 1:** Plan and implement a stormwater outfall sampling pilot project within a subwatershed<br>• **Years 2-5:** Complete an evaluation and analysis of the pilot project and its potential application within the entire CARP watershed. Based on the evaluation of pilot project data, the project may be implemented for the entire CARP watershed Data collection should |

| | |
|---|---|
| | continue throughout the life of this I-Plan. Provide five-year Management Measure Activity 2.3 progress report. |
| **Interim, Measurable Milestones** | • Plan and implement a stormwater outfall sampling pilot project within a subwatershed of the impaired AUs.<br>• Plan and implement a stormwater outfall<br>• Sampling project for the entire CARP watershed. |
| **Monitoring Component** | • **Programmatic:** If a correlation between bacteria levels and outfall flow was found, implementation progress for this management measure would be tracked through the number of public notifications sent out pertaining to water quality. Five-year report.<br>• **Environmental:** Collect stormwater flow data within the CARP watershed. |
| **Responsible Parties** | The CARP Coordinating Committee envisions a cooperative effort including the City of Corpus Christi, local universities, residents, and local research and data collection organizations such as CCS, CBBEP, etc. |

# Management Measure 3.0: Research

Bacteria levels at the Cole Park and Ropes Park beaches are a concern as reflected in the TMDL document. The TMDL study provides a general description of the extent and character of bacteria exceedances in the impaired AUs. This will be a dynamic process where the stakeholders continually expand their knowledge of the sources and effects of bacteria at the impaired AUs and where various management approaches are tested and refined. This section identifies potential research topics that will be critical to this undertaking.

These topics are pertinent to the entire Corpus Christi Bay area and are intended to be implemented as resources become available. Research will be conducted using appropriate methodology and quality assurance that will be developed in consultation with the appropriate parties.

A variety of funding sources should be pursued, with a wide spectrum of partners. It is unlikely that any one local entity will find it feasible to conduct this research alone. Given the large-scale character of the undertakings, entities should look to coordinate efforts with the various academic institutions in the area, federal and state agencies like EPA and the Texas Department of State Health Services, water and environmental research groups, and similar potential partners. A shared project, the result of an inter-local agreement or similar instrument, may allow local entities to feasibly investigate these issues. Parts of, or entire, projects described below could be undertaken by graduate students or researchers at local universities and research institutions.

Results of the following projects are intended to be used for evaluation of the effectiveness of current and future I-Plan management measures, as well as other measures currently being undertaken by the City of Corpus Christi and other entities to reduce bacteria loading in Corpus Christi Bay.

Because the results of the following research project will be instrumental in the adaptive-management of this I-Plan, all research activities should begin as soon as possible (ideally within year one of implementation). Results should be shared with CARP stakeholders in order to be integrated into I-Plan revisions at the five-year review. The applicability of this section for academic researchers' and graduate students' research projects should not be overlooked.

The Monitoring and Research workgroup identified six priority research topics for this I-Plan management measure:

*3.1) Evaluate Methods to Remove Bacteria with GI*

*3.2) Bacterial Source Tracking*

*3.3) Evaluate the Effectiveness of Public Utility Programs and Projects*

*3.4) Investigate New Data Analysis Methodologies for Assessment and Listing of Recreational Beaches on the 303(d) List*

*3.5) Identify Water Flow Patterns in Corpus Christi Bay at Ropes Park Using Dye Testing*

*3.6) Investigate Alternative Sampling Dates for the Texas Beach Watch Program*

## Technical Assistance for Management Measure 3.0

Technical assistance sources for Management Measure 3.0 include governmental, academic, and nonprofit entities with programs that support environmental education for the public, like those entities listed as Responsible Parties in each management measure activity.

## Financial Assistance for Management Measure 3.0

Financial assistance to implement Management Measure 3.0 may come from federal (EPA), state (TCEQ), and local governmental (the City of Corpus Christi) and nonprofit entities. These programs include:

- **CWA Section 319(h) Grants:** EPA provides grant funding to Texas to implement the state's approved NPS Management Program and is administered by TCEQ and TSSWCB. The EPA-approved Texas program provides the framework for determining which activities are eligible for funding under CWA Section 319(h). In general, these activities include non-regulatory programs and are related to controlling NPS pollution. EPA-approved NPS programs cover costs associated with technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of specific NPS projects. (EPA, 2022)
- **Coastal Management Program**: The CMP, administered by NOAA and the TGLO, is a voluntary partnership between the federal government and U.S. Coastal and Great Lake states and territories. It is authorized by the Coastal Zone Management Act of 1972 to address national coastal issues. The Act provides funding for protecting, restoring, and responsibly developing our nation's

diverse coastal communities and resources. To meet the goals of the Act, the National CMP takes a comprehensive approach to coastal resource management—balancing the often competing, and occasionally conflicting, demands of coastal resource use, economic development, and resource conservation. Some of the key elements of the National CMP include protecting natural resources, managing development in high hazard areas, giving development priority to coastal-dependent uses, providing public access for recreation, and coordinating state and federal actions.

- **Coastal Bend Community Foundation Grants**: Donors in the Coastal Bend, through both current and testamentary gifts, have enabled the Foundation to enhance and improve the quality of life through grants to area nonprofit organizations. The Foundation's grants from unrestricted funds cover a broad spectrum of projects from the Arts to Zoology.
- **Urban Water Small Grants:** The objective of the Urban Waters Small Grants Program, administered by EPA, is to fund projects that will foster a comprehensive understanding of local urban water issues, identify and address these issues at the local level and educate and empower the community. The Urban Waters Small Grants Program seeks to help restore and protect urban water quality and revitalize adjacent neighborhoods by engaging communities in activities that increase their connection to, understanding of, and stewardship of local urban waterways.

## Management Measure Activity 3.1. Evaluate Methods to Remove Bacteria with Green Infrastructure

The purpose of this management measure activity is to complete a feasibility study implementing GI concepts to reduce bacteria loading at the beaches in the CARP watershed. Ultimately, if the study indicates that cost-effectiveness and significant reduction in bacteria loads may be achieved through GI usage, then the activities may be pursued for full construction implementation at the appropriate time and with the appropriate measures.

GI is an approach that communities can utilize to maintain healthy waters, provide multiple environmental benefits, and support sustainable communities. Unlike single-purpose gray stormwater infrastructure, which uses pipes to convey stormwater, GI uses vegetation and soil to manage rainwater where it falls. By weaving natural processes into the existing environment, GI provides not only stormwater management but also flood mitigation, air quality management, bay debris management, and more. A GI feasibility study should be completed for the CARP watershed to help determine what impacts it may have on bacteria load reduction at these beaches. Alternatives could include large- and small-scale options, from greenway redesign to rain gardens and rainwater harvesting by residents in single family homes.

A watershed coordinator is recommended to be retained by the preforming party to oversee the implementation of the Corpus Christi Regional I-Plan, as funding allows. Steps involved in this study could include the watershed coordinator working on a

project with a contractor or researcher familiar with implementing GI projects to conduct a feasibility study for the CARP watershed, with the main goal of determining whether GI could be effective at reducing bacteria loads at the impaired AUs. The contractor or researcher should develop a list of alternatives that could be implemented with an estimated percentage of bacteria load reductions for each alternative and a cost associated with each. The CARP stakeholder group could suggest next steps to city staff and council based on results from the feasibility study.

## Education Component

The educational component of this management measure activity will provide the public with GI related activities they can implement at home to reduce bacteria loads, offer GI education for city staff, citizens, local developers, and architects, and inform the public and city staff of the results of the conducted feasibility study.

## Priority Areas

A feasibility study examining GI implementation could be completed for the area surrounding Cole Park and Ropes Park, including the major stormwater outfalls contributing flows to the impaired AUs (primarily Louisiana Avenue and Brawner Parkway). Upstream areas from the parks should also be included in the study, as well as small-scale modifications and other viable concepts.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between the City of Corpus Christi, CARP stakeholders, and applicable engineering firm or researcher will be beneficial to implementing this management measure activity. The City of Corpus Christi, who operates the stormwater infrastructure, will receive recommendations from the feasibility study and should take them into consideration for implementation.

## Measurable Milestones

Contingent on receipt of proposed project funding, measurable milestones include:

- the number of GI education events offered,
- the complete feasibility study,
- after the feasibility study is complete, CARP stakeholders will recommend GI alternatives to the City of Corpus Christi,
- if found feasible, the city will implement one or more GI projects, and
- as possible, continue to evaluate and implement new GI projects based on recommendations from the feasibility study.

## Monitoring Component

Programmatic monitoring of this management measure activity will consist of tracking the number of GI workshops offered, the amount of data produced by the GI feasibility study, and the number of GI projects implemented. Environmental monitoring could be comprised of additional stormwater sampling collected as part of Management

Measure Activity 2.3, and analysis of stormwater sampling data pre- and post-installation to evaluate effectiveness of GI installations. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Year 1:**

- Work with a contractor familiar with GI to complete a feasibility study in the CARP watershed.

**Years 2-5:**

- After the feasibility study is complete, CARP stakeholders will recommend GI alternatives to the City of Corpus Christi.
- If found feasible, the city will implement one or more GI projects.
- Continue to evaluate and implement new GI projects based on recommendations from the feasibility study, as possible.
- Collect additional stormwater samples along with stormwater sampling (Management Measure Activity 2.3).
- Provide five-year Management Measure Activity 3.1 progress report.

## Estimated Load Reductions

According to the study below, GI has the potential to reduce bacteria loading to watersheds. The study found that bioretention can have a net removal of up to 94% of bacteria (Hayes et al. 2022). Estimated Load Reductions were not calculated at this time due to this management measure activity only planning to evaluate GI methods.

**Table 13. Summary of CARP Management Measure Activity 3.1: Evaluate Methods to Remove Bacteria with Green Infrastructure**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | Stormwater runoff |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance Needed** | Will vary depending on data collection methods, funding sources, and responsible parties. |
| **Education Component** | Provide the public with activities they can implement at home to reduce bacteria loads. Provide GI education for city staff, citizens, local developers, and architects. Inform the public and city staff of the results of the conducted feasibility study. |
| **Schedule of Implementation** | • **Year 1:** Complete feasibility study.<br>• **Year 2-5:** After feasibility study complete, CARP stakeholders will recommend GI alternatives to the city. If found feasible, the city will implement GI project. If feasible, continue to evaluate and implement new projects. Collect additional stormwater samples along with stormwater sampling in Management Measure Activity 2.3. Provide five-year Management Measure Activity 3.1 progress report. |

| | |
|---|---|
| **Interim, Measurable Milestones** | • Complete feasibility study.<br>• Number of GI education events offered.<br>• After the feasibility study is complete, CARP stakeholders will recommend GI alternatives to the City of Corpus Christi.<br>• If found feasible, the city will implement one or more GI projects. As possible, continue to evaluate and implement new projects. |
| **Monitoring Component** | • **Programmatic:** GI education events, GI feasibility study, and GI implementation. Five-year report.<br>• **Environmental:** Additional stormwater monitoring. |
| **Responsible Parties** | The City of Corpus Christi, nongovernmental entities that could partner with a contractor, and CARP stakeholders. |

## Management Measure Activity 3.2. Bacterial Source Tracking

The purpose of this management measure activity is to characterize the microbiome of bay water at the Cole Park and Ropes Park TBWP sampling locations during dry conditions and compare it to samples collected after rain events. The samples will be analyzed at an approved National Environmental Laboratory Accreditation Program (NELAP) accredited laboratory. Determining the biota of the organisms and origin of the increased bacterial load will guide implementation of subsequent bacteria reduction efforts.

This activity will further evaluate bacteria sources and persistence to fully comprehend the extent of contributions to bacterial loading and to focus future management actions targeting the largest sources of bacteria.

CARP stakeholders have identified this management measure activity as the first priority activity for implementation. Because many of the management measures recommended in this I-Plan address specific potential bacterial sources, results from bacterial source tracking will guide the prioritization and implementation of subsequent activities and allow for the most efficient allocation of limited resources throughout implementation.

## Education Component

The results of the bacterial source tracking, in the CARP watershed, can be used to tailor future education and outreach events and materials to address specific sources. Results from the study could also be shared with the public during general education and outreach activities (Management Measure 1.0).

## Priority Areas

The priority areas for this management measure activity will be the six TBWP sites located in the CARP watershed (four at Cole Park and two at Ropes Park), pre- and post-rain events.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Research personnel and graduate students with support from educational institutions (TAMUCC, Delmar College, Corpus Christi Independent School District) can

help conduct bacterial source tracking. Samples will be analyzed at an approved NELAP testing laboratory. CBCOG or other local stakeholders can notify the public of bacterial source tracking study results.

## Measurable Milestones

Contingent on receipt of proposed project funding, measurable milestones include:

- beginning sampling upon approval of the I-Plan, and
- the number of samples collected, and
- analyzing the microbiome of bay water samples collected at TBWP sampling locations in the CARP watershed.

## Monitoring Component

The implementation progress for this management measure will be tracked through the sample collection and bacterial source tracking methods to evaluate sources of bacteria. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Year 1:**

- Identify and secure project funding.
- Develop the bacterial source tracking study including sample collection for pre-rain and post-rain events at the TBWP sampling locations and analysis at a NELAP accredited laboratory.
- To be developed upon approval of this I-Plan.

**Years 2-5:**

- Implement the bacterial source tracking study.
- Provide five-year Management Measure Activity 3.2 progress report.

## Estimated Load Reductions

No direct reduction will come from monitoring, but additional data and information will be useful in mitigating bacteria loads based upon the bacterial source tracking study results.

**Table 14. Summary of CARP Management Measure Activity 3.2: Bacterial Source Tracking**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | To be determined by the results of the bacterial source tracking study. |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance Needed** | Financial assistance to be determined. Will vary depending on data collection methods, funding sources, and responsible parties. Research personnel and graduate students with support from educational institutions can provide technical assistance. |

| | |
|---|---|
| **Education Component** | Provide the public with information on the sources of bacteria and how they can reduce loads. Use the study results to tailor education and outreach activities to specific sources identified. |
| **Schedule of Implementation** | • **Year 1:** Identify and secure project funding. Develop the bacterial source tracking study.<br>• **Years 2-5:** Implement the bacterial source tracking program. Provide five-year Management Measure Activity 3.2 progress report. |
| **Interim, Measurable Milestones** | • Number of samples collected.<br>• Analysis of the microbiome of bay water samples collected at TBWP sampling sites in the CARP watershed. |
| **Monitoring Component** | • **Programmatic**: Five-year report.<br>• **Environmental:** Use sample collection and bacterial source tracking methods to evaluate sources of bacteria. |
| **Responsible Parties** | Research personnel and graduate students with support from educational institutions (TAMUCC, Delmar College, Corpus Christi Independent School District). Samples will be analyzed at an approved NELAP testing laboratory. |

## Management Measure Activity 3.3. Evaluate the Effectiveness of Public Utilities Programs and Projects

The purpose of this management measure activity is to examine the effects of City of Corpus Christi programs on bacteria levels in the CARP watershed and to evaluate the efficiency of those programs in improving water quality.

Evaluation of the effectiveness of current and future public utility programs and projects in the CARP watershed will help demonstrate the relative success of different management practices. This effort would draw from current and proposed activities undertaken by the City of Corpus Christi. The effectiveness studies would include both structural and behavioral measures. Structural measures might be based on both traditional drainage engineering, such as specifications for stormwater outfalls and sustainable infrastructure design methodologies, such as GI and LID. Behavioral measures might include public outreach, public reporting of illicit discharges, and other efforts aimed at changing behaviors. The data collected and the results from the comparative evaluations should be made available to all stakeholders.

## Education Component

The education component of this management measure activity includes educating the public on the successful programs the city is implementing.

## Priority Areas

The priority areas for this management measure activity will be the CARP watershed, and the subwatershed of Brawner Parkway located adjacent to the Ropes Park watershed.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between the City of Corpus Christi, CARP stakeholders, and

other local stakeholders (such as engineering professionals or research personnel) will be beneficial to implementing this management measure activity.

## Measurable Milestones

Contingent on receipt of proposed project funding, measurable milestones include:

- completing a plan to determine the effectiveness of the city's current and proposed public utilities programs and projects, and
- implementing the plan.

## Monitoring Component

The implementation progress for this management measure activity will be tracked as the evaluation of the effectiveness of Public Utilities Programs and Projects progresses. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Year 1:**

- Identify and secure project funding.
- Develop a plan to determine the effectiveness of the city's current and proposed public utility programs and projects.

**Years 2-5:**

- Implement a study to evaluate the effectiveness of the city's current and proposed public utilities programs and projects.

Years 4-5:

- Educate the public on successful programs the city is implementing.
- Provide five-year Management Measure Activity 3.3 progress report.

## Estimated Load Reductions

No direct reduction will come from evaluating the effectiveness of existing measures, but the additional data and information will be useful in mitigating bacteria loads based on the results.

**Table 15. Summary of CARP Management Measure Activity 3.3: Evaluate the Effectiveness of Public Utilities Programs and Projects**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | To be determined by study outcome. |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance Needed** | Technical assistance from engineering professionals or research personnel at nongovernmental entities may be needed to properly evaluate the effectiveness of structural stormwater measures, GI, and LID. |

| | |
|---|---|
| **Education Component** | Educate the public on successful programs the city is implementing. |
| **Schedule of Implementation** | • **Year 1:** Develop a plan to determine the effectiveness of the city's current and proposed public utility programs and projects.<br>• **Years 2-5:** Implement a study to evaluate the effectiveness of the city's current and proposed public utilities programs and projects.<br>• **Years 4-5:** Educate the public on successful programs the city is implementing. Provide five-year Management Measure Activity 3.3 progress report. |
| **Interim, Measurable Milestones** | Develop and implement a study to evaluate the effectiveness of public utility programs and projects. |
| **Monitoring Component** | **Programmatic:** The implementation progress for this management measure will be tracked as the effectiveness project progresses. Five-year report. |
| **Responsible Parties** | The City of Corpus Christi and the watershed coordinator coordinating with partners as needed. |

# Management Measure Activity 3.4. Investigate New Data Analysis Methodologies for Assessment and Listing of Recreational Beaches on the 303(d) List

The purpose of this management measure activity is to evaluate the methodology for assessment and listing of recreational beaches on the 303(d) list.

Elevated bacteria levels at Cole Park and Ropes Park during certain times of the year (e.g., after rainfall events, times of heavy recreation, etc.) pose a health risk to recreational users. Alternative methodologies should be explored to justify listing recreational beaches on the 303(d) list.

## Texas Beach Watch Program Bacteria Sampling

TGLO administers the TBWP which collects water samples from 164 stations at 62 recreational beaches along the Texas coast in Aransas, Brazoria, Cameron, Galveston, Harris, Jefferson, Matagorda, Nueces, and San Patricio counties. Sample collection occurs weekly (one time at each station) during the peak beach season (March through October) and bi-weekly from November through February. TGLO maintains a website[7] where maps and bacteria data are available. Bacteria results are updated as sample data are entered in the TBWP database. During peak beach season, May through September, water samples are collected weekly and during off season samples are collected bi-weekly.

In accordance with the federal BEACH Act of 2000, TBWP advisories are issued when a single sample exceeds the BAV of 104 cfu/100 mL of the indicator bacteria Enterococci. Local government entities typically post Beach Watch advisory signs at beach access points and issue advisories that warn the public not to swim in affected waters when bacterial levels are exceeded. Once issued, that beach is subject to continued monitoring every 24 hours until bacteria levels fall below 104 cfu/100 mL.

[7] www.texasbeachwatch.com/

All samples are collected under a quality assurance project plan (QAPP) consistent with TCEQ bacteria collection and analysis protocols.

TCEQ is provided with a compilation of all beach data collected and analyzed by TGLO under the TBWP. For all available data, the total number of advisory days is divided by the total number of samples collected. If there are numerous sites monitored at one beach area, only one advisory is counted per beach per day. TCEQ includes beach advisory information in the assessment process used to develop the Texas Integrated Report by identifying beaches with persistent advisories. Data assessment guidance and methodology is provided with each Texas Integrated Report. The most recently approved guidance at the time of this report's development was the 2022 Guidance for Assessing and Reporting Surface Water Quality in Texas[8].

The TCEQ assessment process consists of identifying the percentage of days each beach is under an advisory. TCEQ then categorizes the beach segments using the following scale:

- Beach advisories < 20% of the time—Fully Supporting
- Beach advisories 20-25% of the time—Concern and Fully Supporting
- Beach advisories < 20% of the time—Delisted and Fully Supporting
- Beach advisories ≥ 25% of the time—Not Supporting

If a beach is under an advisory for more than 25% of the days sampled, TCEQ will list the beach as impaired. Due to human health considerations, all impairments identified using this method are considered Category 5a. A water body is listed as Category 5a on the 303d list because available data and/or information indicate at least one designated or existing use is not being supported and TMDLs are underway or scheduled.

Water quality data will continue to be collected by TGLO under the TBWP. TCEQ will continue to identify trends and compliance with the BAV to protect human health by identifying beaches with persistent advisories. If persistent advisories continue and standards are not attained after TMDL development, TCEQ and watershed stakeholders may reevaluate the TMDL and/or I-Plan and take appropriate actions to further investigate and mitigate sources of bacteria to the beaches.

The current methodology requires samples to be taken consecutively after an initial beach advisory, until the bacteria levels decrease below the contact recreation threshold. For public safety, this is a sufficient sampling method, but for listing beaches on the 303(d) list, it could potentially be improved upon. CARP stakeholders will investigate and discuss alternative sampling methodology with the appropriate agencies.

CARP stakeholders will coordinate with independent researchers to complete a review of the current data analysis process used for assessment and listing recreational

[8]www.tceq.texas.gov/downloads/water-quality/assessment/integrated-report-2022/2022-guidance.pdf

beaches on the 303(d) list. Any proposed amendments to the methodology for listing of recreational beaches on the 303(d) list would need to be discussed and approved by the Surface Water Quality Assessment Advisory Work Group, TCEQ, TGLO, and EPA.

## Education Component

The education component of this management measure activity will include an education and outreach campaign to inform the public on the current methods for evaluating beach water quality. This measure also plans to solicit input from the professional community in the form of surveys, as to the effectiveness of the current beach assessment methodologies.

## Priority Areas

The priority areas for this management measure activity will include recreational beaches throughout the state of Texas.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Governmental entities responsible for monitoring and assessing waterbodies may provide technical assistance for this study. Research personnel and graduate students with support from educational institutions may coordinate with independent researchers to complete the project.

## Measurable Milestones

Contingent on receipt of proposed project funding, measurable milestones include:

- developing a database of survey responses from professionals regarding the current methodology to assess recreational beaches in Texas,
- completing a project with independent researchers to evaluate the assessment methodology, and
- reviewing project results and discussion of the project findings with appropriate government agencies.

## Monitoring Component

The implementation progress for this management measure activity will be tracked as the project progresses. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Year 1:**

- Identify and secure project funding.
- Identify independent researchers to coordinate with.
- Educate the public on current recreational beach assessment methodologies.

**Years 2-4:**

- Compile a database of professional responses.
- Review data with the appropriate agencies.
- Implement project to investigate new data analysis methodologies for future listings of recreational beach impairments.

**Year 5:**

- Communicate project results and propose any new methodologies for listing of recreational beaches on the 303(d) list to the appropriate agencies.
- Provide five-year Management Measure Activity 3.4 progress report.

## Estimated Load Reductions

An investigation into new data analysis methodologies for assessment and listing recreational beaches on the 303(d) list will not lead to load reductions.

**Table 16. Summary of CARP Management Measure Activity 3.4: Investigate New Data Analysis Methodologies for Assessment and Listing Recreational Beaches on the 303(d) List**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | N/A |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance Needed** | Technical assistance for this management measure activity may come from the governmental entities listed in the Responsible Parties section. Source of funding to be determined. Governmental entities responsible for monitoring and assessing waterbodies may provide technical assistance for this study. |
| **Education Component** | An education and outreach campaign will be created to inform the public on the current methods for evaluating beach water quality. Solicit input from the professional community. |
| **Schedule of Implementation** | • **Year 1:** Identify and secure project funding. Identify independent researchers to coordinate with. Educate and survey the public on current recreational beach assessment methodologies.<br>• **Years 2-4:** Compile a database of public responses and review data with the appropriate agencies. Implement project to investigate new data analysis methodologies for future listings of recreational beach impairments.<br>• **Year 5:** Communicate project results and propose any new methodologies for listing of recreational beaches on the 303(d) list to the appropriate agencies. Provide five-year Management Measure Activity 3.4 progress report. |
| **Interim, Measurable Milestones** | • Number of responses from the survey of local professionals.<br>• Complete a project with independent researchers to evaluate the assessment methodology.<br>• Review project results and discussion of the project findings with appropriate government agencies. |
| **Monitoring Component** | **Programmatic:** Public outreach and education events held. Evaluation of survey responses. Five-year report. |
| **Responsible Parties** | CARP stakeholders in coordination with research personnel and graduate students with support from educational institutions |

## Management Measure Activity 3.5. Identify Water Flow Patterns in Corpus Christi Bay at Ropes Park Using Dye Testing

The purpose of this management measure activity is to understand the impact of the Brawner Parkway stormwater outfall discharge at Ropes Park on bacteria levels.

Water flow patterns within Corpus Christi Bay may have a significant effect on the bacteria concentrations at Cole Park and Ropes Park. Stormwater loading from the Louisiana Avenue and Brawner Parkway outfalls may be the largest contributors of bacteria to Corpus Christi Bay, due to watershed size, geographic extent, location, and outfall size. While the effect of the Louisiana Parkway drainage on the Cole Park area is more defined, it is unclear what effect the Brawner Parkway drainage has on Ropes Park.

Rhodamine dyes have been used over the years in water flow and particle research. By placing probes that can detect this dye north of the Brawner Parkway outfall and adding this dye to the Brawner Parkway drainage system prior to rain events, flow patterns can be studied.

Known costs to implement this project include: the purchase and installation of two to four probes that can be used with Rhodamine dye, data collection and possible relocation of the probes to develop a complete understanding of water flow during rain events, and the development of a report with conclusions on the impact of the Brawner Parkway outfall on water quality.

## Education Component

Results of this management measure activity will educate the public and professionals on water flow in the CARP watershed through maps showing where water flows in the bay, especially after rain events.

## Priority Areas

The priority area for this management measure activity is the CARP watershed, with a focus on the area between the Brawner Parkway outfall and Ropes Park.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. TAMUCC has several departments with researchers that have equipment and expertise to conduct a water flow study using approved dye methods and develop a QAPP, (should it be required,) with support from the City of Corpus Christi. Grant funding through CBBEP or CMP could be applied for to fund research conducted by an appropriate group from TAMUCC.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- developing and implementing a dye testing procedure,
- identifying focus for future action by the City of Corpus Christi if the Brawner Parkway outfall is shown to have a large influence on the Ropes Park watershed, and
- compiling a final report that details the finding from dye testing.

## Monitoring Component

Tracking implementation progress of this management measure activity will be through the implementation of dye testing during rain events and monitoring the flow. Results from the dye testing will be assessed in a report. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Year 1:**

- Locate and attain funding required for this management measure.
- Plan dye testing procedures at the Brawner Parkway outfall in the Ropes Park watershed.

**Years 2-4:**

- Implement the dye testing study at the Brawner Parkway outfall in the Ropes Park watershed.

**Year 5:**

- Complete a report that details an assessment of the findings from the dye testing of the Brawner Parkway outfall.
- Identify focus for future action by the City of Corpus Christi if the Brawner Parkway outfall is shown to have a large influence on Ropes Park sampling.
- If possible, develop maps that demonstrate the flow of stormwater runoff from the Brawner Parkway outfall and its impact on Ropes Park.
- Provide five-year Management Measure Activity 3.5 progress report.

## Estimated Load Reductions

No load reduction was calculated for this measure, however information gathered as a result of this management measure will be useful in mitigating bacteria loads and watershed planning into the future.

**Table 17. Summary of CARP Management Measure Activity 3.5: Identify Water Flow Patterns in Corpus Christi Bay at Ropes Park Using Dye Testing**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | N/A |
| **Potential Load Reduction** | N/A |

| | |
|---|---|
| **Technical and Financial Assistance** | Funding may come from grants provided by entities such as CBBEP, CMP, or in-kind resource contributions. Technical assistance may be provided through TAMUCC, with support from the City of Corpus Christi. |
| **Education Component** | Educate the public on stormwater runoff and show maps of where water flows in the bay, especially after rain events. |
| **Schedule of Implementation** | • **Year 1:** Locate and attain funding required for this management measure. Plan dye testing procedures at the Brawner Parkway outfall in the Ropes Park watershed.<br>• **Years 2-4:** Implement the dye testing study at the Brawner Parkway outfall in the Ropes Park watershed.<br>• **Year 5:** Complete a report that details an assessment of the findings from the dye testing of the Brawner Parkway outfall. Provide five-year Management Measure Activity 3.5 progress report. |
| **Interim, Measurable Milestones** | • Develop and implement a dye testing procedure.<br>• Identify focus for future action by the City of Corpus Christi if Brawner Parkway outfall can be shown to have a large influence on Ropes Park sampling.<br>• Comple a final report that details the finding from dye testing. |
| **Monitoring Component** | • **Programmatic:** Number of events held to educate the public and share results of study. Five-year report.<br>• **Environmental:** Implement dye testing during rain events and monitor flow. |
| **Responsible Parties** | City of Corpus Christi and TAMUCC |

## Management Measure Activity 3.6. Investigate Alternative Sampling Dates for the Texas Beach Watch Program

The purpose of this management measure activity is to evaluate the current TBWP sampling schedule to provide the public with information about water quality at in the CARP watershed on the weekends when beach traffic is highest.

Elevated bacteria levels in the CARP watershed during certain times of the year (e.g., after rainfall events, times of heavy recreation, etc.) pose a health risk to recreational users. These health risks might not be accurately conveyed to recreational users based on the day of week the beaches are currently sampled. Weekend sampling, when visitation numbers are at their highest, rather than the current protocol of sampling on Wednesdays, could better represent the risks posed to the public. If monitoring were to take place closer to the weekend, the data could better reflect weekend values encountered by recreational users and better protect public health.

## Education Component

Sampling information is readily available to the public on the TBWP website.[9]

## Priority Areas

The priority areas for this management measure activity are the six TBWP sites located within the CARP watershed (four located at Cole Park and two at Ropes Park).

[9] https://www.texasbeachwatch.com/

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. CARP stakeholders will discuss changing sampling dates with TGLO and their contractors. It should be noted that if TGLO made this change, an estimated $20,000 annually would be needed to support the change of sampling dates due to increases in weekend and overtime staffing costs. TGLO would also need to identify a NELAP accredited laboratory providing water quality collection and analysis services on the weekend. This cost would increase if more locations than those currently at Cole Park and Ropes Park were added.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- discussions with TGLO on sampling dates, and
- locating and attaining funding if changes are agreed upon by all parties and implemented.

## Monitoring Component

Implementation progress of this management measure activity will be tracked by reporting meeting outcomes between responsible parties and whether the sampling day can be changed. A five-year report will be submitted to TCEQ summarizing all activities related to this management measure activity.

## Implementation Schedule

**Years 1-5:**

- CARP stakeholders will discuss changing sampling days from Wednesday to Thursday or Friday with TGLO.
- Provide five-year Management Measure Activity 3.6 progress report.

## Estimated Load Reductions

No load reduction was calculated for this measure.

**Table 18. Summary of CARP Management Measure Activity 3.6: Investigate Alternative Sampling Dates for the Texas Beach Watch Program**

| Key Elements | Summary |
|---|---|
| **Causes and Sources** | N/A |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance Needed** | An estimated annual cost of $20,000 would be needed to support the change of sampling. Identification of a NELAP-accredited laboratory that provides weekend services to collect and assess water quality samples will be necessary. |
| **Education Component** | Information about recreational beach sampling is available on the TBWP website. |

| | |
|---|---|
| **Schedule of Implementation** | **Years 1-5:** CARP stakeholders will discuss changing sampling days with TGLO. Provide five-year Management Measure Activity 3.6 progress report. |
| **Interim, Measurable Milestones** | • Discussions with TGLO on sampling dates.<br>• Locate and attain funding if changes are agreed upon by all parties and implemented. |
| **Monitoring Component** | **Programmatic:** Implementation progress of this management measure will be tracked by reporting meetings between responsible parties to complete the management measure and whether the sampling day can be changed. Five-year report. |
| **Responsible Party** | CARP stakeholders |

# Management Measure 4.0: Wastewater Collection System Enhancements

Sanitary sewers can fail to function properly due to blockages, line breaks, defects that allow stormwater and groundwater to overload the system, lapses in operation and maintenance (O&M), inadequate design and construction, power failures, deferred replacement, and vandalism. SSOs contribute to bacteria loading in many impaired streams, but they may or may not be the primary source of loading.

In general, SSOs are caused by I/I into the collection system due to aging and deteriorating infrastructure such as leaky pipes, fault pipe joints, or defective manholes, etc. Implementation actions that may be taken to mitigate future SSOs can be done through hydraulic modeling, completing an I/I study, education and reduction of FOG entering the collection system, continuing sanitary sewer line cleaning, and reporting SSOs to TCEQ. Information about causes of SSOs[10] and possible preventative measures[11] that can be taken by regulated entities can be found on the TCEQ website[12].The Monitoring and Research workgroup recommended five initial activities for this I-Plan management measure:

*4.1) Continue and Enhance the Existing Fats, Oil, and Grease (FOG) Program*

*4.2) Continue and Expand the Notification System for Monitoring SSOs*

*4.3) Continue and Expand the Collection System Line Cleaning, Inspection, Repair and Rehabilitation*

*4.4) Implement an Inflow and Infiltration (I/I) Study*

*4.5) Continue Hydraulic Modeling of the Collection System*

## Technical Assistance for Management Measure 4.0

Technical assistance sources for Management Measure 4.0 include governmental, academic, and nonprofit entities with programs that support environmental education for the public, like those entities listed as Responsible Parties in each management measure activity.

[10] https://www.tceq.texas.gov/downloads/compliance/publications/gi/gi-389.pdf
[11] https://www.tceq.texas.gov/downloads/compliance/publications/rg/rg-395.pdf
[12] https://www.tceq.texas.gov/compliance/investigation/ud-sso

## Financial Assistance for Management Measure 4.0

Financial assistance to implement the Management Measure 4.0 may come from federal (EPA), state (TCEQ), and local (City of Corpus Christi) governmental and nonprofit entities. These programs include:

- **Regional Solid Waste Grants Program**: TCEQ provides grants to regional councils of governments to fund solid waste management activities and various local and regional projects that help implement solid waste management plans.
- **Environmental Education Grants**: Under the Environmental Education Grants Program, EPA seeks grant proposals from eligible applicants to support environmental education projects that promote environmental stewardship and help develop knowledgeable and responsible students, teachers, and citizens. This grant program supplies financial support for projects that design, show, or teach environmental education practices, methods, or techniques as described in the Environmental Education Grant Program solicitation notices.
- **Sewer Overflow and Stormwater Reuse Municipal Grants Program:** Grants are awarded to states, which then provide awards to eligible entities for projects that address infrastructure needs for SSOs and stormwater management.
- C**oastal Bend and Bays Estuaries Program**: The CBBEP is a non-regulatory, partnership-led effort working with industry, environmental groups, bay users, local governments and resource managers to protect and restore the health and productivity of bays and estuaries.
- **Clean Water State Revolving Fund:** The Clean Water State Revolving Fund (CWSRF) program is a federal-state partnership that provides communities low-cost financing for a range of water quality infrastructure projects. The program functions as an environmental infrastructure bank by providing low-interest loans to eligible recipients for water infrastructure projects. Assistance can be provided for construction of publicly owned treatment works, decentralized wastewater treatment systems, and measures to manage, reduce, treat, or recapture stormwater or subsurface drainage water, among others.

## Management Measure Activity 4.1. Continue and Enhance the Existing FOG Program

The purpose of this management measure activity is to reduce or eliminate SSOs caused by FOG blockages through education and outreach to residents and the continuation, and possible enhancement, of the existing City of Corpus Christi FOG program, including monitoring and enforcing ordinances prohibiting grease input into the wastewater collection system. FOG are considered a leading cause of blockages in sanitary sewers. EPA estimates that blockages account for nearly 50% of all SSOs nationwide (EPA, 2004).

The City of Corpus Christi determines the proper size and design for grease interceptors, inspects traps regularly, and requires grease interceptors to be effectively maintained by businesses. Almost all the city's food service establishments (FSEs) are

required to have a grease interceptor, which is initially enforced by the city's Development Services through the building permit process. Thereafter, FSEs are inspected annually by the city's pre-treatment staff. Inspections include reviewing manifests for grease interceptor cleaning frequency and analyzing hexane extractible material (HEM) levels, which cannot exceed 200 milligrams/liter. The hexane solvent methodology is used to measure total oils and grease. A Notice of Violation is sent to FSEs where exceedance is observed, with a requirement to increase the interceptor cleaning frequency. Continued exceedances may result in a requirement for a larger or more effective interceptor.

## Educational Component

The educational component for this management measure activity will include distributing informational pamphlets in City of Corpus Christi utility bills, at Earth Day Bay Day, World of Water event at the Corpus Christi Museum of Science and History, and similar events throughout the city where residents can receive information on problems associated with disposing of FOG down drains. The city provides fat trapper containers and bags at no charge to attendees at public events. This management measure activity will continue education and outreach directed to permit holders and citizens about FOG.

## Priority Areas

The priority area for this management measure activity is all residents and FSEs in the CARP watershed.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. City of Corpus Christi Public Utilities Department should coordinate with the CCNCPHD FSE Program, CARP stakeholders, FSE owners and other government, academic, and nonprofit entities as appropriate.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- the continuation of the existing monitoring and enforcement of the city's ordinances,
- the number of FSE inspections by city staff,
- the number of grease traps repaired or replaced as a result of an inspection,
- the coordination between CARP stakeholders and city staff to discuss an increase of monitoring and enforcement of the FOG Program,
- the continuation of education and outreach to the public on problems associated with disposing of FOG down drains, and
- a decrease in the number of SSOs associated with FOG in the CARP watershed.

# Monitoring Component

Implementation progress of the management measure will be tracked by the number of food service grease interceptors that are inspected, and by the reduction in the number of SSOs associated with FOG reported. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Years 1-5:**

- Continue the existing monitoring and enforcement of the city's FOG ordinances prohibiting grease input into the wastewater collection system.
- Coordinate with city staff to possibly increase food service grease interceptor maintenance and inspections.

**Years 2-5:**

- Continue monitoring FSEs and HEM.
- Continue public education efforts with the city's FOG program.
- Provide five-year Management Measure Activity 4.1 progress report.

# Estimated Load Reductions

FOG blockages are the primary cause in 40-50% of all SSOs (Southerland, R. 2002). According to the CARP TMDL, there were 40 SSOs between January 2016 and February 2019 (3.083 years) totaling in an estimated volume of 22,202 gallons (TCEQ, 2021). An estimated 7,201.427gallons of waste from SSOs finds its way into the watershed per year. If grease traps can be improved through city programs as proposed by Management Measure Activity 6.4, then it is estimated that 45% of SSOs could be prevented per year, which would result in approximately, 3,240.642 gallons of SSOs that could be prevented annually. If FOG traps could be evaluated by the City of Corpus Christi to be effective, then the TMDL watershed could see a potential load reduction of 21,467.53 billion cfu/100 ml per year of Enterococci.

$$Load_{FOG} = \text{Average Volume} \times ALR \times FC \times \text{Conversion}$$

Where:

***Load***$_{FOG}$ = Average potential Enterococci load reduction, 21,467.53 billion cfu/100 ml per year.

***Average Volume*** = 12,267,159.51 mL. The total SSO volume (mL) for the watershed from January 2016 to February 2019 is 22,202 gallons, making the estimated SSO volume per year due to FOG 3,240.642 gallons. This value was multiplied by 3,785.41 mL/gallon to convert to mL.

***ALR =*** 45% of potential load reduction (Southerland R. 2002)

***FC*** = 0.01 billion cfu/mL Fecal coliform concentration in sewage (EPA, 2001)

***Conversion*** = .175, Conversion from fecal coliform to Enterococci (Borel et al. 2012).

**Table 19. Summary of CARP Management Measure Activity 4.1: Continue and Enhance the Existing FOG Program**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | SSOs associated with FOG |
| **Potential Load Reduction** | 21,467.53 billion cfu/yr |
| **Technical and Financial Assistance Needed** | City of Corpus Christi Public Utilities, the CCNCPHD FSE Program, and other governmental, academic and nonprofit entities as appropriate. Additional funding will need to be added to the City of Corpus Christi Public Utilities annual operating budget to accomplish the goals of this management measure activity. |
| **Education Component** | Continue education and outreach directed to FSEs and citizens associated with the city's FOG program. Distribute informational pamphlets in City of Corpus Christi utility bills, at Earth Day Bay Day, and similar events throughout the city where residents can receive information on problems associated with disposing of grease down drains. |
| **Schedule of Implementation** | • **Year 1:** Continue the existing monitoring and enforcement of the city's FOG ordinances prohibiting grease input into the wastewater collection system. Coordinate with city staff to possibly increase food service grease interceptor maintenance and inspections.<br>• **Years 2-5:** Continue monitoring FSEs and HEM. Continue public education efforts with the city's FOG program. Provide five-year Management Measure Activity 3.6 progress report. |
| **Interim, Measurable Milestones** | • The continuation of the existing monitoring and enforcement of the city's ordinances.<br>• The number of FSE inspections by city staff.<br>• The number of grease traps repaired or replaced as a result of an inspection.<br>• Coordination between CARP stakeholders and city staff to discuss an increase of monitoring and enforcement of the FOG Program.<br>• The continuation of education and outreach to the public on problems associated with disposing of FOG down drains<br>• Decrease in the number of SSOs associated with FOG in the CARP watershed. |
| **Monitoring Component** | **Programmatic**: Progress will be tracked by the number of food service grease interceptors inspected and by the reduction in the number of SSOs associated with FOG. Five-year report. |
| **Responsible Parties** | A partnership between the City of Corpus Christi Public Utilities Department, the CCNCPHD FSE Program and FSE owners in the CARP watershed. The watershed coordinator can help to educate the public about FOG and educational events. |

## Management Measure Activity 4.2. Continue and Expand the Notification System for Monitoring SSOs

The purpose of this management measure activity is to continue the monitoring of SSOs and create a public notification system to expand reporting when SSOs occur. This may include a website, social media platforms, and/or cell phone notifications.

The SSO Initiative (SSOI) is a voluntary program that aims at addressing increases in SSOs due to aging collection systems throughout the state and encourages corrective action before there is harm to human health and safety or the environment. Municipalities choose to take part in the voluntary SSOI Program by contacting TCEQ. Benefits of participation include (1) not being subject to formal enforcement by TCEQ for most continuing SSO violations, if the overflows are addressed by the SSO plan, and (2) participation allows the municipality to direct resources towards corrective actions rather than having to pay penalties associated with an enforcement order in addition to the corrective actions.

All SSOs are reported to TCEQ by the City of Corpus Christi's Public Utilities Department. It is city policy that all reported overflows are repaired or addressed. The intent of this management measure is to expand the SSO reporting and notification by the City of Corpus Christi to other interested parties.

## Educational Component

The educational component of this management measure activity will include enhancing public outreach and education to inform the public where to find SSO information.

## Priority Areas

The priority area for this management measure activity is the CARP watershed, but the notification system could apply to the City of Corpus Christi jurisdictional boundary.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. The City of Corpus Christi Public Utilities Department and the CCNCPHD FSE Program currently report SSOs to TCEQ. Coordination between the city, CARP stakeholders, and other local stakeholders would be beneficial to implementing this management measure activity.

## Measurable Milestones

Contingent on receipt of proposed project funding, measurable milestones are:

- the continuation of current SSO monitoring and reporting including the number of SSOs reported to TCEQ, and the number of SSOs repaired or remediated,
- the coordination with the city to discuss, plan, and implement an expanded SSO public notification system for other interested groups, and
- the dissemination of information about the expanded program to the public.

## Monitoring Component

Implementation progress of the management measure activity will be tracked through the effectiveness of the city's reporting and addressing of SSOs including public notification for public health/safety and the number of SSOs reported to TCEQ. Once the expanded SSO reporting system is created, track how the public uses it. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Years 1-5:**

- Continue to report SSOs to TCEQ and repair and remediate as needed.
- Coordinate with city staff to discuss, plan, and create an expanded SSO public notification system which may include a website, social media platforms, and/or cell phone notifications.
- Compare number of reported SSOs year to year to see if a reduction is occurring.
- Provide five-year Management Measure Activity 4.2 progress report.

## Estimated Load Reduction

Load reduction calculations were not calculated for this management measure activity due to this management measure activity only planning implementation for outreach and education events.

**Table 20. Summary of CARP Management Measure Activity 4.2: Continue and Expand the Notification System for Monitoring SSOs**

| Key Elements | Summary |
|---|---|
| **Causes and Sources** | N/A |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance Needed** | City of Corpus Christi Public Utilities Department operating budget, CCNCPHD FSE Program. If funding is needed beyond what the operating budget provides, then funding sources may include entities such as CBBEP or EPA. Technical assistance sources would include governmental, academic, and nonprofit entities as appropriate. |
| **Education Component** | Public outreach and education to inform people where SSO information can be found. |
| **Schedule of Implementation** | **Years 1-5:** Continue to report SSOs to TCEQ and repair and remediate as needed. Coordinate with city staff to discuss, plan, and create an expanded SSO public notification system which may include a website, social media platforms, and/or cell phone notifications. Compare number of reported SSOs year to year in order to see if a reduction is occurring. Provide five-year Management Measure Activity 4.2 progress report. |

| | |
|---|---|
| **Interim, Measurable Milestones** | • The continuation of current SSO monitoring and reporting including the number of SSOs reported to TCEQ, and the number of SSOs repaired or remediated.<br>• Coordination with the city to discuss, plan, and implement an expanded SSO public notification system for other interested groups<br>• The dissemination of information about the expanded program to the public. |
| **Monitoring Component** | • **Environmental:** Monitor number of SSOs reported to TCEQ.<br>• **Programmatic:** Number of SSOs displayed on public platform. Tracking the public's use of the expanded SSO reporting system. Five-year report. |
| **Responsible Parties** | City of Corpus Christi Public Utilities Department and CCNCPHD FSE Program currently report SSOs to TCEQ and may coordinate with CARP stakeholders, and other local stakeholders to expand the notification system. |

## Management Measure Activity 4.3. Continue and Expand Collection System Line Cleaning, Inspection, Repair, and Rehabilitation

The purpose of this management measure activity is to prevent overflows and increase collection system capacity. Maintenance of collection system lines is a City of Corpus Christi Public Utilities Department function to provide improved performance to approximately 83,000 customers who depend on daily service.

The City of Corpus Christi has an on-going program of cleaning and televised inspection of its wastewater collection system. This is part of the Wastewater Department's maintenance and operation plan for improved performance. Through cleaning and televising, the city can optimize repair and rehabilitation efforts. In addition to continuing this program, CARP stakeholders recommend expanding the program by developing additional monitoring techniques that may be more accurate or cost effective, such as smoke testing

Annually, the city's Public Utilities Department assesses the collection system to determine areas that may need improved maintenance and repairs. Areas needing replacement are placed on the Capital Improvements Program (CIP) plan for bid solicitation. Also, database reviews occur to resolve problematic areas in the system.

## Educational Component

The educational component of this management measure activity will include notifying the public on why and when collection system line cleaning, repairs, or monitoring techniques are completed, and keeping the public informed of project development for the city's wastewater collection system.

## Priority Areas

CARP stakeholders recommend that pilot projects or expansion of the current program be focused on the CARP watershed.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. The City of Corpus Christi Public Utilities Department, along with competitively bid contracts, maintains the city's wastewater collection system. Additional projects (e.g., a smoke testing pilot project) could be undertaken by research entities or local environmental groups in partnership with the city, such as TAMUCC, Texas A&M University Kingsville (TAMUK), and nonprofit entities (e.g., CBBEP and others).

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- funding for line cleanings reviewed,
- number of lines cleaned, inspected, repaired, and/or rehabilitated,
- funding for smoke testing or other monitoring technique pilot project identified,
- plan and implement a smoke testing pilot project in the CARP watershed,
- expanding new monitoring techniques throughout the city wastewater collection system if proven to be beneficial, and
- reduce and prevent the number of SSOs in the collection system and increase system capacity.

## Monitoring Component

The implementation progress of this management measure activity will be tracked by continuing the program already in place for monitoring the wastewater collection system. If feasible, CARP stakeholders may also track and monitor progress made using new monitoring techniques as part of the pilot program in the CARP watershed. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Years 1-5:**

- Inform the public of plans to prevent SSOs and increase system capacity by performing maintenance of lines through cleaning, the use of closed-circuit television (CCTV), and other monitoring techniques.
- Review and respond to customer complaints in the affected areas, seeking problem resolution and improvements of the system.
- Continue the City of Corpus Christi's Wastewater Department's maintenance and operation plan for overall system improvement, prevention of SSOs, and increased system capacity.
- Identify and secure project funding for the smoke detection pilot project, within the CARP watershed.
- Develop the pilot project including coordination with appropriate city programs and other stakeholders.

**Years 2-5:**

- Conduct planning and implementation of pilot project for the CARP watershed.
- Provide five-year Management Measure Activity 4.3 progress report.

## Estimated Load Reductions

Various factors can cause SSOs including clogged and broken collection system lines. According to the CARP TMDL, there were 40 SSOs within January 2016 to February 2019 (3.083 years) totaling in a volume of 22,202 gallons. An estimated 7,201.43 gallons of SSOs find their way into the watershed per year. If SSOs are completely prevented by improving and expanding the city's existing collection system maintenance program for items such as line cleaning and inspection, repair and rehabilitation, there is a potential load reduction of 47,705.62 billion cfu/year Enterococci.

$$Load_{sso} = Average\ Volume \times FC \times Conversion$$

Where:

***Load***$_{sso}$ = Average potential Enterococci load reduction, 47,705.62 billion cfu/year.

***Average Volume*** = 27,260,354.47 mL, the total SSO volume (mL) for the watershed from 2016-2019 is 22,202 gallons, making the estimated SSO volume per year 7,201.43 gallons. This value was multiplied by 3,785.41 mL/gallon to convert to mL (TCEQ, 2021).

***FC*** = 0.01 billion cfu/mL Fecal coliform concentration in sewage (EPA, 2001)

***Conversion*** =.175, conversion from fecal coliform to Enterococci (Borel et al. 2012)

**Table 21. Summary of CARP Management Measure Activity 4.3: Continue and Expand Collection System Line Cleaning, Inspection, Repair, and Rehabilitation**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | SSOs |
| **Potential Load Reduction** | 47,705.62 billion cfu/yr |
| **Technical/Financial Assistance Needed** | Technical assistance sources would include governmental, academic, and nonprofit entities. Financial assistance may be needed for a pilot project in the CARP watershed. Funding may be possible through the city's CIP or other wastewater grant programs. |
| **Education Component** | Notify public on collection system line cleaning repairs and smoke detection. Keep the public informed of project development. |

| | |
|---|---|
| **Schedule of Implementation** | • **Years 1-5:** Inform the public of plans to prevent SSOs and increase system capacity by performing maintenance of lines through cleaning, the use of closed-circuit television (CCTV), and other monitoring techniques. Review and respond to customer complaints in the affected areas, seeking problem resolution and improvements of the system. Continue the City of Corpus Christi's Wastewater Department's maintenance and operation plan for overall system improvement, prevention of SSOs, and increased system capacity. Identify and secure project funding for the smoke detection pilot project within the CARP watershed. Develop the pilot project including coordination with appropriate city programs and other stakeholders.<br>• **Years 2-5:** Conduct planning and implementation of pilot project for the CARP watershed. Provide five-year Management Measure Activity 4.3 progress report. |
| **Interim, Measurable Milestones** | • Review the funding for line cleanings.<br>• Number of lines cleaned, inspected, repaired, and/or rehabilitated.<br>• Funding for smoke testing or other monitoring technique pilot project identified.<br>• Plan and implement a smoke detection pilot project in the CARP watershed,<br>• Expand new monitoring techniques throughout the city wastewater collection system if proven to be beneficial.<br>• Reduction in the number of SSOs in the collection system. |
| **Monitoring Component** | • **Programmatic:** Develop pilot program for the CARP watershed. Five-year report.<br>• **Environmental:** Continue monitoring, notification, and response for collection system. |
| **Responsible Parties** | The City of Corpus Christi Public Utilities Department, and contractors, maintain the city's wastewater collection system.<br>The pilot project could be undertaken by research entities or local environmental groups in partnership with the city. |

## Management Measure Activity 4.4. Implement an Inflow and Infiltration Study

The purpose of this management measure activity is to develop a long-term I/I program to locate and repair system defects. Infiltration is groundwater that seeps into sewer pipes and inflow is stormwater that quickly flows into sewer lines. Both instances can cause damage to sewer lines and increased bacteria loadings in the watershed. Rainfall distribution analysis, wet-weather flow data, rainfall dependent inflow/infiltration (RDII), and other variables will help prioritize sub-basins for future testing and rehabilitation. The I/I study is part of the Capacity, Management, Operation, and Maintenance (CMOM) self-audit, following EPA guidance criteria. It will precede and be incorporated into the hydraulic modeling project (Management Measure Activity 4.5), which will be discussed in the following management measure activity.

The City of Corpus Christi has an on-going citywide flow monitoring program to prioritize sub-basins based on various factors such as RDII, SSOs, and maintenance history. The monitoring program is intended to address issues which may cause negative impacts on human health or the environment. The city is also developing a program to determine needed wastewater infrastructure modifications and improvements to ensure adequate collection system conveyance capacity. This management measure activity is designed to enhance the city's efforts.

## Educational Component

The educational component of this management measure activity will provide the results of the I/I study to the public.

## Priority Areas

The priority area for this management measure activity will include the entirety of the City of Corpus Christi's collection system to determine the need for improved maintenance and repairs.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. The City of Corpus Christi Public Utilities Department, along with competitively bid contracts, maintains the city's wastewater collection system. The I/I study could be undertaken by research entities or local environmental groups in partnership with the city and/or contractors.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- develop a long-term I/I program to find and fix system defects,
- rank meter sub-basins,
- prepare a sanitary sewer evaluation survey, and
- complete an I/I study report and share results with the public.

## Monitoring Component

The implementation progress of this management measure activity will be tracked by conducting flow monitoring, developing of a long-term I/I program to find and fix system defects, and data analysis from flow monitoring throughout the collection system. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Year 1:**

- Identify and secure funding for an I/I study.
- Determine and identify flow monitoring site locations for the I/I study.

**Years 2-5:**

- Conduct flow monitoring according to the I/I study plan.
- Data collection and analysis from I/I study plan.
- Analyze flow and infiltration data to determine where wastewater infrastructure needs modifications/improvements to ensure adequate collection system conveyance capacity.

**Year 5:**

- Complete I/I study report and share results with the public.
- Based on the results of the study, develop a long term I/I program.
- Provide five-year Management Measure Activity 4.4 progress report.

# Estimated Load Reductions

No load reduction was calculated for this management measure activity, however additional data and information resulting from the I/I study may be useful in mitigating the bacteria load in the future.

**Table 22. Summary of CARP Management Measure Activity4.4: Implement an Inflow and Infiltration Study**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | Wastewater infrastructure defects due to I/I. |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance Needed** | Technical assistance sources may include governmental, academic and nonprofit entities. Financial assistance may come from the City of Corpus Christi Public Utilities Department operating budget. If funding is needed beyond what the operating budget provides then funding sources may include entities such as CWSRF, EPA, or others. Technical assistance sources would include governmental, academic, and nonprofit entities, as well as private contractors as needed. |
| **Education Component** | Provide the results of the I/I study to the public. |
| **Schedule of Implementation** | • **Year 1**: Identify and secure funding for an I/I study. Determine and identify flow monitoring site locations for the I/I study.<br>• **Years 2-5:** Conduct flow monitoring according to the I/I study plan. Data collection and analysis from I/I study plan. Analyze flow and infiltration data to determine where wastewater infrastructure needs modifications/improvements to ensure adequate collection system conveyance capacity.<br>• **Year 5:** Complete I/I study report and share results with the public. Based on the results of the study, develop a long term I/I program. Provide five-year Management Measure Activity 4.4 progress report. |
| **Interim, Measurable Milestones** | • Develop a long-term I/I program to find and fix system defects.<br>• Rank meter sub-basins.<br>• Prepare a sanitary sewer evaluation survey.<br>• Complete an I/I study report and share results with the public. |
| **Monitoring Component** | • **Programmatic:** Five-year report.<br>• **Environmental:** Monitoring will be completed throughflow monitoring in the collection system, development of long-term I/I program, and data analysis from monitoring in collection system. |
| **Responsible Parties** | The City of Corpus Christi Public Utilities Department, along with competitively bid contracts, maintains the city's wastewater collection system. The I/I study could be done by the city or by research entities or local environmental groups in partnership with the city and/or contractors. |

## Management Measure Activity 4.5. Continue Hydraulic Modeling of Collection System

The purpose of this management measure activity is to prevent SSOs and increase system capacity. A hydraulic wastewater system model equips the City of Corpus Christi Wastewater Department with a tool for analyzing system conveyance capacities, bottlenecks, and potential SSO locations. The hydraulic model enables the city to assess any potential capacity constraints and to develop strategies to optimize system performance.

The City of Corpus Christi has an on-going CMOM program to address issues and developed a comprehensive citywide hydraulic model of the wastewater collection system in 2020. The hydraulic model, SewerGEMS, facilitates understanding of the root causes contributing to bacteria in the bay, aids in development of system improvements, produces informational maps and exhibits, and recommends the system's response to future improvements.

## Educational Component

The educational component of this management measure activity will provide data results from hydraulic modeling study to city staff and the public and incorporate informational maps and exhibits produced from the study into education and outreach activities.

## Priority Areas

The modeling project is broken into two phases based on the treatment plant service areas of greatest priority within the CARP watershed. Phase 1 consists of Oso, Greenwood, and Broadway Wastewater Treatment Plants service areas. Phase II incorporates other service areas in the system.

## Responsible Parties and Funding

Each organization listed will be responsible only for expenses associated with its own efforts: The City of Corpus Christi Public Utilities Department and associated project contractors.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- tracking the number of SSOs throughout the collection system as improvements are made to determine effectiveness of study-based improvements,
- assurance of collection system capacity, and
- ranking of sub-basin-based results as a result of the CMOM Program.

## Monitoring Component

Monitoring for this management measure activity will be through flow monitoring and tracking the number of SSOs in areas where the CMOM Program has been

implemented. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Years 1-2:**

- Continuation of the City of Corpus Christi's hydraulic wastewater system model.

**Years 2-5:**

- Data collection and analysis to locate potential infrastructural issues that are leading to increased bacteria loadings in sanitary sewers.
- Development of prioritized system improvement program as a result of the hydraulic model and CMOM program.

**Year 5:**

- Incorporate maps and exhibits produced from the hydraulic model study into education and outreach activities.
- Provide five-year Management Measure Activity 4.5 progress report.

## Estimated Load Reductions

No load reductions are associated with this management measure activity, however additional data and information as a result of the hydraulic modeling and CMOM program may be useful in mitigating the bacteria load in the future.

**Table 23. Summary of CARP Management Measure Activity 4.5: Continue Hydraulic Modeling of Collection System**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | N/A |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance Needed** | City of Corpus Christi Public Utilities Department operating budget. Grant funding may be available through other government and nonprofit entities. |
| **Education Component** | Provide data results from hydraulic modeling study to the public. |
| **Schedule of Implementation** | • **Years 1-2:** Continuation of the City of Corpus Christi's hydraulic wastewater system model.<br>• **Years 2-5:** Data collection and analysis to locate potential infrastructural issues that are leading to increased bacteria loadings in sanitary sewers. Development of prioritized system improvement program as a result of the hydraulic model and CMOM program.<br>• **Year 5:** Incorporate maps and exhibits produced from the hydraulic model study into education and outreach activities. Provide five-year Management Measure Activity 4.5 progress report. |

| | |
|---|---|
| **Interim, Measurable Milestones** | • Reduction in SSOs.<br>• Collection system capacity assurance.<br>• Ranking of sub-basin-based results. |
| **Monitoring Component** | • **Programmatic:** Five-year report.<br>• **Environmental:** Tracking number of SSOs and conduct flow monitoring. |
| **Responsible Parties** | City of Corpus Christi Public Utilities Department and contractors |

# Management Measure 5.0: Stormwater Drainage System

State and federal rules require cities and certain other entities to obtain permits for controlling stormwater pollution. These regulated MS4s are publicly owned systems of conveyances and includes ditches, curbs, gutters, and storm sewers that do not connect to a wastewater collection system or treatment facility. There are two types of MS4 permits—Phase I and Phase II. Both types of permits regulate discharges of stormwater into surface water in the state. Phase I permits were issued for MS4s that had a population of 100,000 or more. The Phase II permits were first issued following EPA approval of the Phase II rules in 1990. More information about MS4s, classification, and regulatory requirements specific to Texas is available at TCEQ's Stormwater Permits webpage[13].

Phase II MS4 regulations are implemented through a general permit under which MS4s in Urbanized Areas (UAs), as defined most recently in 2010 by the U.S. Census, are authorized to discharge stormwater. The Texas Pollutant Discharge Elimination System (TPDES) MS4 Phase II rules require municipalities and certain other public entities in UAs to obtain permit coverage for their stormwater systems. Like a Phase I MS4, the Phase II MS4 general permit requires that SWMPs specify the BMPs to meet several MCMs that, when implemented in concert, are expected to result in significant reductions of pollutants discharged into receiving water bodies. Phase II MS4 MCMs include the following:

- Public education, outreach, and involvement.
- Illicit discharge detection and elimination.
- Construction site stormwater runoff control.
- Post-construction stormwater management in new development and redevelopment.
- Pollution prevention and good housekeeping for municipal operations.
- Industrial stormwater sources[14].
- Authorization for construction activities where the small MS4 is the site operator (optional).

The purpose of this management measure is to continue MS4 program requirements to reduce bacteria loadings in stormwater through adaptive management approaches.

[13] https://www.tceq.texas.gov/permitting/stormwater

[14] MCM only applies to Phase II MS4s which serve a population of 100,000 or more

These approaches may be through BMPs related to stormwater infrastructure modifications such as aeration, treatment by sunlight, or physical removal of contaminants which all have the potential to reduce bacteria loading into waterways. Due to limited data regarding how well such BMPs (i.e., GI) might reduce bacteria loading, CARP stakeholders have identified evaluation of the effectiveness of GI as one of its priorities.

The Monitoring and Research workgroup recommended five initial activities for this management measure:

*5.1) Continue Existing Stormwater Programs*

*5.2) Continue Drainage System Line Cleaning, Inspection, Repair and Rehabilitation*

*5.3) Determine the Effectiveness of Stormwater Retrofits to Remove Bacteria*

*5.4) Enhance the Major Outfall Assessment and Repair Program*

*5.5) Support and Encourage the Stormwater Master Plan*

## Technical Assistance for Management Measure 5.0

Technical assistance sources for Management Measure 5.0 include governmental, academic, and nonprofit entities with programs that support environmental education for the public, like those entities listed as Responsible Parties in each management measure activity.

## Financial Assistance for Management Measure 5.0

Financial assistance to implement the Management Measure 5.0 may come from federal (EPA), state (TCEQ), and local governmental (City of Corpus Christi) and nonprofit entities. These programs include:

- **CWA Section 319(h) Grants:** EPA provides grant funding to Texas to implement the state's approved NPS Management Program and is administered by TCEQ and TSSWCB. The EPA-approved Texas program provides the framework for determining which activities are eligible for funding under CWA Section 319(h). In general, these activities include non-regulatory programs and are related to controlling NPS pollution. EPA-approved NPS programs cover costs associated with technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of specific NPS projects. (EPA, 2022)
- **Clean Water State Revolving Fund:** The Clean Water State Revolving Fund (CWSRF) program is a federal-state partnership that provides communities low-cost financing for a range of water quality infrastructure projects. The program functions as an environmental infrastructure bank by providing low-interest loans to eligible recipients for water infrastructure projects. Assistance can be provided for construction of publicly owned treatment works, decentralized wastewater treatment systems, and measures to manage, reduce, treat, or recapture stormwater or subsurface drainage water, among others.

- **Sewer Overflow and Stormwater Reuse Municipal Grants Program:** Grants are awarded to states, which then provide awards to eligible entities for projects that address infrastructure needs for SSOs and stormwater management.

## Management Measure Activity 5.1. Continue Existing Stormwater Programs

The goal of this management measure activity is to continue existing TPDES permit programs to reduce pollutants entering the City of Corpus Christi's MS4. The City of Corpus Christi, Del Mar College, the Port Authority and TAMUCC are permitted to discharge stormwater runoff through their Phase I MS4 permits. To comply with their permit, the City of Corpus Christi employs extensive stormwater pollution prevention programs, as well as land development programs which address bacteria sources identified in this I-Plan. These programs should be continued and modified as deemed appropriate by the city. Information about the City of Corpus Christi's stormwater system can be found on their website.[15]

The continuation of the existing SWMP throughout the city will ensure the introduction of pollutants into the MS4 is minimized to the maximum extent practicable.

## Education Component

Phase I MS4 permits are required to implement strategies that promote public education, outreach, and involvement in their SWMPs. The City of Corpus Christi will continue to promote public education and outreach as a part of their SWMPs through their existing programs and establish new programs, as needed. Additionally, SWMPs require that permittee employees be trained in stormwater management. The City of Corpus Christi will continue to provide training to their employees as part of their SWMP.

## Priority Areas

The priority area for this management measure activity will be stormwater conveyances in and around the CARP watershed.

## Responsible Parties and Funding

Each organization listed will be responsible only for expenses associated with its own efforts: governmental agencies (such as EPA, TCEQ, City of Corpus Christi, CBCOG and others); the City of Corpus Christi, Del Mar College District, Port of Corpus Christi Authority of Nueces County and TAMUCC are all permittees in the MS4 area and therefore responsible parties for this management measure activity.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- continuation of approved SWMP for the City of Corpus Christi's Phase 1 MS4,

[15] https://www.cctexas.com/departments/storm-water/about-our-system

- employee training on stormwater management, and
- implementation of public education and outreach programs

## Monitoring Component

The City of Corpus Christi will continue to operate under their approved SWMP which includes monitoring of MS4 outfalls, responding to illicit discharges into the MS4, and implementing good sampling measures. TCEQ is responsible for evaluating the city annually through the MS4 permitting process. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Year 1:**

- Continue to operate under the approved SWMP.

**Year 2:**

- Propose modifications to the existing SWMP using adaptive management. techniques that are deemed appropriate by the City of Corpus Christi.
- Continue to operate under the approved SWMP.

**Years 3-5:**

- Amend the existing SWMP as needed and ensure the introduction of pollutants into the MS4 are minimized to the maximum extent practicable.
- Continue to operate under the approved SWMP.
- Provide five-year Management Measure Activity 5.1 progress report.

## Estimated Load Reductions

No load reduction was calculated for this management measure activity due to no changes to be implemented.

**Table 24. Summary of Management Measure Activity 5.1. Continue Existing Stormwater Programs**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | N/A |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance Needed** | Technical and financial assistance sources would include federal, state, and local governmental agencies (such as EPA, TCEQ, City of Corpus Christi, CBCOG and others). |
| **Education Component** | The City of Corpus Christi will continue to promote public education and outreach as a part of their SWMPs through their existing programs and establish new programs, as needed. The City of Corpus Christi will continue to provide stormwater management training to their employees as part of their SWMP. |
| **Schedule of Implementation** | • **Years 1-5:** Continuation of existing SWMP for the City of Corpus Christi's Phase I MS4.<br>• **Year 2:** Propose modifications to the existing SWMP using adaptive management techniques that are deemed appropriate by the City of Corpus Christi.<br>• **Years 3-5:** Amend the existing SWMP with the help of the city and ensure the introduction of pollutants into the MS4 is minimized to the maximum extent practicable. Provide five-year Management Measure Activity 5.1 progress report. |
| **Interim, Measurable Milestones** | • Continuation of approved SWMP for the City of Corpus Christi's Phase 1 MS4.<br>• Employee training on stormwater management.<br>• Public education and outreach programs implemented. |
| **Monitoring Component** | • **Programmatic:** The City of Corpus Christi will continue to operate under their approved SWMP which includes responding to illicit discharges into the MS4. TCEQ is responsible for evaluating the city annually through the MS4 permitting process. Five-year report.<br>• **Environmental:** The City of Corpus Christi will continue to operate under their approved SWMP which includes monitoring of MS4 outfalls and implementing good sampling measures. |
| **Responsible Parties** | City of Corpus Christi, Del Mar College District, Port of Corpus Christi Authority of Nueces County and TAMUCC |

## Management Measure Activity 5.2. Continue Drainage System Line Cleaning, Inspection, Repair and Rehabilitation

The purpose of this management measure activity is to maintain drainage system capacity and minimize pollutants entering the drainage system.

The City of Corpus Christi employs preventive maintenance of drainage lines as a stormwater BMP to avoid or mitigate clogged lines to ensure operational effectiveness. Periodically, the city employs two vacuum crews to inspect and service inlets, manholes, lateral lines, and main lines on a planned and emergency schedule. Each of the more than 18,000 inlets in the stormwater inventory are scheduled for servicing at least once every three years with some areas serviced more frequently depending on condition. For example, inlets in the downtown and uptown areas are serviced on a quarterly basis. Additionally, inlets within a special events footprint, such as Buccaneer Days, are cleaned as soon as practical after the conclusion of the event. This inlet, manhole, and line servicing program, coupled with earthen and concrete-lined drainage

channel cleaning, prevents flooding, maintains drainage system reliability, improves performance, and minimizes the discharge of debris and other pollutants into the receiving waters.

## Education Component

Phase I MS4 permits are required to implement strategies that promote public education, outreach, and involvement in their SWMPs. The City of Corpus Christi will continue to promote public education and outreach as part of their SWMP through their existing programs and establish new programs, as needed. Additionally, SWMPs require that permittee employees be trained in stormwater management. The City of Corpus Christi will continue to provide training to their employees as part of their SWMP.

## Priority Areas

The priority area for this management measure activity will be stormwater conveyances in and around the CARP watershed.

## Responsible Parties and Funding

Each organization listed will be responsible only for expenses associated with its own efforts: the City of Corpus Christi, Del Mar College District, Port of Corpus Christi Authority of Nueces County, TAMUCC and federal, state, and local governmental agencies (such as EPA, TCEQ, City of Corpus Christi, CBCOG and others).

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- improved flow capacity, and
- the number of cleaned, inspected and repaired pipes.

## Monitoring Component

The City of Corpus Christi will continue to operate under their approved SWMP which includes monitoring of MS4 outfalls, responding to illicit discharges into the MS4, and implementing good sampling measures. TCEQ is responsible for evaluating the city annually through the MS4 permitting process. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Years 1-5:**

- Continue routine and emergency maintenance of the city's stormwater drainage system by cleaning inlets, manholes, lateral lines and main lines, channel grading, and debris removal.
- Provide five-year Management Measure Activity 5.2 progress report.

## Estimated Load Reductions

No load reduction was calculated for this measure due to no changes to be implemented.

**Table 25. Management Measure Activity 5.2. Continue Drainage System Line Cleaning, Inspection, Repair and Rehabilitation**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | N/A |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance Needed** | City of Corpus Christi Public Utilities Department |
| **Education Component** | The City of Corpus Christi will continue to promote public education and outreach as a part of their SWMP through their existing programs and establish new programs, as needed. The City of Corpus Christi will also continue to provide stormwater management training to their employees as part of their SWMP. |
| **Schedule of Implementation** | **Years 1-5:** Continue routine and emergency maintenance of the city's stormwater drainage system by cleaning inlets, manholes, lateral lines, main lines, channel grading, and debris removal. Provide five-year Management Measure Activity 5.2 progress report. |
| **Interim, Measurable Milestones** | • Improved flow capacity.<br>• Track of the number of cleaned, inspected and repaired pipes. |
| **Monitoring Component** | • **Programmatic:** The city's continued response to illicit discharges into the MS4. Tracking of the number of monitored, inspected and repaired drainage lines. Five-year report.<br>• **Environmental:** City Continue monitoring of MS4 outfalls and implementing good sampling measures. Stormwater programs are evaluated annually by TCEQ is responsible for evaluating the city annually through the MS4 permitting process. |
| **Responsible Parties** | City of Corpus Christi, Del Mar College District, Port of Corpus Christi Authority of Nueces County and TAMUCC |

## Management Measure Activity 5.3. Determine the Effectiveness of Stormwater Retrofits to Remove Bacteria

The purpose of this management measure activity is to determine if stormwater retrofits can effectively reduce bacteria in stormwater from urban runoff by retrofitting existing infrastructure.

Retrofits are defined as, "stormwater treatment practices in stream corridors or upland areas to capture and treat stormwater runoff before it flows into the receiving water" (Schueler et al. 2007). Some examples of retrofits, which may assist in reducing bacteria concentrations in stormwater, include diverting flows through constructed wetlands, exposing previously underground flows to sunlight, or diverting runoff to wet ponds.

As funding is identified and becomes available, the City of Corpus Christi, or other CARP stakeholders, should perform a small-scale pilot program on a public improvement project using a site-specific engineered stormwater retrofit in the CARP

watershed. As part of this small-scale pilot program, and identifying the specific pilot project location, a detailed survey of the stormwater collection system in one or two of the small drainage basins in the study area should be included.

After the site stormwater retrofit is completed, water quality monitoring should occur at the inflow and outflow of the retrofit to determine the effectiveness of bacteria removal. The results of this pilot project should be used to determine if retrofits to existing infrastructure are effective in reducing Enterococcus levels in stormwater runoff.

## Educational Component

The educational component of this management measure activity will include educating the public on stormwater retrofits and distributing educational materials to the public.

## Priority Areas

The priority area for this management measure activity will be the CARP watershed. The site-specific pilot project location is to be determined with assistance of an engineering consulting firm in partnership with the City of Corpus Christi and other CARP stakeholders as appropriate.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. The City of Corpus Christi Public Works Department maintains the city's stormwater collection system. Coordination between the city, CARP stakeholders, research entities, academic (e.g., TAMUCC and TAMUK), and local nonprofit groups (e.g., CBBEP) will be beneficial to implement the small-scale pilot program to plan and implement a site-specific engineered stormwater retrofit in the CARP watershed.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- number of educational materials produced, and individuals reached,
- funding source is identified and secured,
- development and execution of a small-scale retrofit pilot project in the CARP watershed,
- monitoring of bacteria levels at the inflow and outflow of the retrofit
- development of a report from the pilot project to determine if stormwater retrofits can effectively reduce bacteria in stormwater runoff for the CARP watershed.

## Monitoring Component

Implementation progress will be tracked by the number of retrofits installed. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

# Implementation Schedule

**Year 1:**

- Identify and secure funding for the engineered stormwater retrofit and effectiveness monitoring.
- Complete a detailed survey of the stormwater collection system in one or two of the small drainage basins and identify the specific location for the retrofit.

**Year 2:**

- Design and construct the stormwater retrofit.

**Years 3-4:**

- Monitor bacteria levels at the inflow and outflow of the retrofit and determine effectiveness.
- Develop and execute a small-scale retrofit pilot project in the CARP watershed.

**Year 5:**

- CARP stakeholders will develop retrofit recommendations based on the data collected in the pilot study.
- Develop recommendations for further stormwater retrofits.
- Provide five-year Management Measure Activity 5.3 progress report.

# Estimated Load Reductions

Studies on bacteria reduction from stormwater retrofits have found that on average, biofiltration had a bacterial removal rate of 92% (Tilman et al. 2011). If biofiltration retrofits were implemented, for a pilot study in the subwatersheds of Ropes/Carroll Basin, seven acres could be managed (Center for Coastal Studies, 2015). If seven acres of the watershed were managed through stormwater retrofitting, there is a potential bacteria reduction of up to 2.55 billion cfu/year. This reduction of bacteria in the watershed could be increased by the expansion of stormwater retrofits in the CARP watershed.

$$Load_{SR} = SA_{SR} \times ALR_{SR} \times UR_{SR} \times Conversion$$

Where:

$Load_{SR}$ = estimated load reduction from implementation of stormwater retrofits, 2.55 billion cfu/year.

$SA_{SR}$= 7 acres, Ropes/Carroll drainage basin treatment acreage

$ALR_{SR}$ = 92%, average load reduction from biofiltration (Tilman et al. 2011)

$UR_{SR}$= 2.23 billion cfu/acre/year urban runoff loading of fecal coliform (Herrera, 2011)

$Conversion$ = .175 conversion from fecal coliform to Enterococci.

**Table 26. Summary of CARP Management Measure Activity 5.3: Determine the Effectiveness of Stormwater Retrofits to Remove Bacteria**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | Urban stormwater runoff |
| **Potential Load Reduction** | 2.55 billion cfu/year |
| **Technical and Financial Assistance Needed** | Technical assistance would include governmental (e.g., EPA), academic (e.g., TAMUCC and TAMUK), and nonprofit entities (e.g., CBBEP). Financial assistance to be determined. |
| **Education Component** | Educate the public on stormwater retrofits and distribute educational materials to the public. |
| **Schedule of Implementation** | • **Year 1:** Identify and secure funding for the engineered stormwater retrofit and effectiveness monitoring. Complete a detailed survey of the stormwater collection system in one or two of the small drainage basins and identify the specific location for the retrofit.<br>• **Year 2:** Design and construct the stormwater retrofit.<br>• **Years 3-4:** Monitor bacteria levels at the inflow and outflow of the retrofit and determine effectiveness.<br>• **Year 5:** CARP stakeholders will develop retrofit recommendations based on the data collected in the pilot study. Develop recommendations for further stormwater retrofits. Provide five-year Management Measure Activity 5.3 progress report. |
| **Interim, Measurable Milestones** | • Number of educational materials produced, and individuals reached.<br>• Funding source is identified and secured.<br>• Development and execution of a small-scale retrofit pilot project.<br>• Monitoring at the inflow and outflow to determine effectiveness report findings to the CARP stakeholders.<br>• Determine if stormwater retrofit(s) can effectively reduce bacteria in stormwater runoff for the CARP watershed. |
| **Monitoring Component** | **Programmatic:** Assess retrofits annually to determine if repairs are needed. Five-year report. |
| **Responsible Parties** | The City of Corpus Christi may assist other nongovernmental entities, such as research entities, academic, or local nonprofit groups with a small-scale pilot program to plan and implement a site-specific engineered stormwater retrofit in the CARP watershed. |

## Management Measure Activity 5.4. Enhance the Major Outfall Assessment and Repair Program

The purpose of this management measure activity is to enhance the ongoing maintenance and repair of stormwater outfalls, as needed, which may influence Cole Park and Ropes Park. Verifying the integrity and function of outfall structures will ensure the carrying capacity of the system is protected, while minimizing sediment deposition and the input of other pollutants due to physical defects and system failures. As funding and technological advances become available, the City of Corpus Christi, with support and assistance from CARP stakeholders (as needed), is suggested to evaluate the feasibility of retrofitting structurally unsound outfalls, if found, that may affect water quality at Cole Park and Ropes Park with new technology to incorporate water quality improvements.

There are eight major and more than 80 minor stormwater outfalls that flow into Corpus Christi Bay. Currently, the city allocates funding in the Capital Budget for the Major Outfall and Assessment and Repair Program to service the entire stormwater system. Areas such as the CARP watershed should be a high priority due to elevated bacteria at recreational beaches. This management measure activity suggests enhancements to the ongoing Major Outfall Assessment and Repair Program instituted by the City of Corpus Christi, as funding allows.

## Educational Component

The educational component of this management measure activity will include notifying the public about the repair program and providing results from the assessment.

## Priority Areas

Priority areas for this management measure activity will be at outfall locations that may affect water quality at Cole Park and Ropes Park.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. The City of Corpus Christi Public Works Department maintains the city's stormwater collection system and the Major Outfall Assessment and Repair Program. Coordination between the city, CARP stakeholders, research entities, academic entities (e.g., TAMUCC and TAMUK), and local nonprofit groups (e.g., CBBEP) will be beneficial to suggest specific enhancements to the Major Outfall Assessment and Repair Program.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- continue the existing Major Outfall Assessment and Repair Program to assess the condition of major outfalls,
- condition assessments should rank and prioritize outfall repairs or replacements, as needed, in the CARP watershed,
- the number of assessments completed in the CARP watershed,
- when major repairs or replacements are warranted, the project should be evaluated to determine the feasibility of new retrofits for water quality improvements,
- the project engineer should develop a list of alternatives (incorporating new technologies) that could be implemented for stormwater runoff water quality improvements, and
- the number of public notifications of assessment results.

## Monitoring Component

Monitoring progress of this management measure activity will be through the continuation of the assessment program, as funding permits, and expanding to other basins that may impact water quality at Cole Park and Ropes Park. A five-year report

will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Year 1:**

- CARP stakeholders will coordinate with the city to make suggestions on enhancing the Major Outfall Assessment and Repair Program and prioritizing outfalls that may impact Cole Park and Ropes Park.

If the city agrees to the enhancements and funding is secured, these additional steps may be taken:

**Years 2-5:**

- Assess outfalls within Cole Park and Ropes Park.
- Develop repair/retrofit recommendations incorporating new technologies, when feasible.
- Conduct project and prepare report of findings that include conditions of existing outfalls and their priority rank to be repaired or replaced in the CARP watershed.
- Educate the public on the assessment results.
- Provide five-year Management Measure Activity 5.4 progress report.

## Estimated Load Reductions

Research has shown that BMPs for major outfalls can lead to bacteria load reductions of 90% in Enterococci levels (Mallin et. al., 2015). If BMPs can be implemented through the enhancement of the City of Corpus Christi's Major Outfall Assessment and Repair Program at stormwater outfalls draining 25% of the CARP watershed, there could be a potential load reduction of 393.70 billion cfu/year of Enterococci.

$$Load_{EMO} = WA_{EMO} \times ALR_{EMO} \times UR_{EMO} \times Conversion$$

Where:

$Load_{EMO}$ = estimated load reduction from implementation of enhancement of major outfalls, 393.70 billion cfu/year.

$WA_{EMO}$= 1,103 acres, 25% of the CARP watershed

$ALR_{EMO}$ = 90%, average load reduction from implementation of major outfall BMPs (Mallin et. al., 2015).

$UR_{EMO}$= 2.23 billion cfu/acre/year, urban runoff loading of fecal coliform (Herrera, 2011)

$Conversion$= .175 conversion from fecal coliform Enterococci

**Table 27. Summary of CARP Management Measure Activity 5.4: Enhance the Major Outfall Assessment and Repair Program**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | Urban stormwater runoff |
| **Potential Load Reduction** | 393.70 billion cfu/year |
| **Technical and Financial Assistance Needed** | Technical assistance may be available from sources such as governmental (e.g., EPA, TCEQ), academic (e.g., TAMUCC and TAMUK), and nonprofit entities (e.g., CBBEP). Sources of financial assistance have yet to be determined. |
| **Education Component** | Notify public about the repair program and provide results from the assessment |
| **Schedule of Implementation** | • **Year 1:** CARP stakeholders will coordinate with the city to make suggestions on enhancing the Major Outfall Assessment and Repair Program and prioritizing outfalls that may impact Cole Park and Ropes Park.<br>If the city agrees to the enhancements and funding is secured, these additional steps may be taken:<br>• **Years 2-5:** Assess outfalls within Cole Park and Ropes Park. Develop repair/retrofit recommendations incorporating new technologies, when feasible. Conduct project and prepare report of findings that include conditions of existing outfalls and their priority rank to be repaired or replaced in the CARP watershed. Educate the public on the assessment results. Provide five-year Management Measure Activity 5.4 progress report. |
| **Interim, Measurable Milestones** | • Continue the existing Major Outfall Assessment and Repair Program to assess the condition of major outfalls.<br>• Condition assessments should rank and prioritize outfall repairs or replacements, as needed, in the CARP watershed.<br>• Number of assessments completed in the CARP watershed.<br>• When major repairs or replacements are warranted, the project should be evaluated to determine the feasibility of new retrofits for water quality improvements.<br>• The project engineer should develop a list of alternatives (incorporating new technologies) that could be implemented for stormwater runoff water quality improvements.<br>• Number of public notifications of assessment results. |
| **Monitoring Component** | **Programmatic:** Continue the assessment program, as funding permits, expanding to other basins that may impact water quality at Cole Park and Ropes Park. Five-year report. |
| **Responsible Parties** | City of Corpus Christi to continue maintaining the city's stormwater collection system and the Major Outfall Assessment and Repair Program. CARP stakeholders to coordinate with the city to suggest specific enhancements. |

## Management Measure Activity 5.5. Support and Encourage the Stormwater Master Plan

The purpose of this management measure activity is to support and encourage the City of Corpus Christi's Stormwater Master Plan that incorporates water quality protection incentives. CARP stakeholders would encourage the city's leadership and staff to adhere to the Stormwater Master Plan, develop design standards, and modify the city Code of Ordinances as needed.

In April 2013, the Level of Service for the plan was presented and approved by the Corpus Christi City Council. The Level of Service, which is the first step in adopting the plan and is a Council-level policy approval item, allows city departments the ability to proceed with developing design standards and updating maps. The city successfully adopted a Stormwater Master Plan in October 2023.

The approved Level of Service and the plan are predicates to amending existing development and construction codes to reflect adopted changes. The city will be reengaging with a design consultant to assess the impact of the revised Level of Service and feasibility of incorporating stormwater quality criteria in the master plan.

## Educational Component

Plan and encourage stakeholder activity in support of the Stormwater Master Plan through workshops and making the Stormwater Master Plan available to the public. Educational workshops will target community groups and interested stakeholders to be involved and support the Corpus Christi's Comprehensive Plan (Plan CC)[16]and other long-term city planning efforts. Plan CC is a 20-year comprehensive plan, started in 2016, that creates policy and strategic framework for the City of Corpus Christi, including the new Stormwater Master Plan.

## Priority Areas

The priority area for this management measure activity will be the City of Corpus Christi.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between the City of Corpus Christi's Development Services, Capital Improvement Programs, and Public Utilities Departments with support from local organizations such as CARP, CBBF, CBBEP, governmental (e.g., EPA, TCEQ), academic (e.g., TAMUCC and TAMUK), and nonprofit entities (e.g., CBBEP, AIA, CBBF) will be beneficial to implementing this management measure activity.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- start engagement with stakeholders and community groups through workshops to be involved and support the Storm Water Master Plan, Plan CC and other long-term city planning efforts,
- the number of members and meetings related to the Stormwater Master Plan support team, and
- the number of community-wide workshops for developing Stormwater Master Plan support and education.

[16]www.cctexas.com/plancc

## Monitoring Component

Programmatic monitoring of effectiveness for this management measure activity will consist of reviewing the Stormwater Master Plan annually to determine if revisions are needed and tracking the number of education activities conducted, meetings completed, and workshops held related to supporting the Stormwater Master Plan. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

### Years 1-5:

- Create Stormwater Master Plan support team, through meeting opportunities for the public and local stakeholders.
- Hold two educational workshops.
- Track improved stormwater management within the watershed.
- Provide five-year Management Measure Activity 5.5 progress report.

## Estimated Load Reductions

There is no estimated load reduction for this management measure activity, however, load reductions as a result of the Stormwater Master Plan may be possible in the future with additional data and analysis.

**Table 28. Summary of CARP Management Measure Activity 5.5: Support and Encourage the Stormwater Master Plan**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | N/A |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance Needed** | Technical assistance may be provided from various governmental and nonprofit entities such as EPA or CBBEP. Financial assistance may be provided by the City of Corpus Christi. |
| **Education Component** | Plan, support and encourage stakeholder activity in support of the Stormwater Master Plan through workshops and making the Stormwater Master Plan available to public. |
| **Schedule of Implementation** | **Years 1-5:** Create Stormwater Master Plan support team, through meeting opportunities for the public and local stakeholders. Hold two educational workshops. Track improved stormwater management within the watershed. Provide five-year Management Measure Activity 5.5 progress report. |
| **Interim, Measurable Milestones** | • Start engagement with stakeholders and community groups through workshops to be involved and support the Storm Water Master Plan, Plan CC and other long-term city planning efforts.<br>• Number of members and meetings related to the Stormwater Master Plan support team.<br>• Number of community-wide workshops for developing Stormwater Master Plan support and education. |
| **Monitoring Component** | **Programmatic:** Review the city's Stormwater Master Plan annually and determine if revisions are needed. Track the number of educational workshops and meetings held in relation to the Master Plan support group. Five-year report. |

| | |
|---|---|
| **Responsible Parties** | The City of Corpus Christi's Development Services, Capital Improvement Programs, and Public Utilities Departments with support from local organizations such as CARP, CBBF, CBBEP, and other similar organizations. |

# Management Measure 6.0: Ordinances and Regulation Improvements

Using the information obtained in Management Measure Activity 5.3, the detailed survey of the stormwater collection system in one or two of the small drainage basins should be used to determine whether illegal cross connections or broken/leaking wastewater laterals are a source of bacteria in the CARP watershed and whether Management Measure Activities 6.1 - 6.3 need to be expanded or prioritized in years 5-10.

The Monitoring and Research workgroup recommended ten initial activities for this I-Plan management measure:

- *6.1) Pre-Sale Inspection and Testing Program of Private Residential Sewer Laterals*
- *6.2) Cross-Connections Inspection Program*
- *6.3) Establishment of a Pilot Sewer Lateral Inspection and Testing Program for Commercial Property*
- *6.4) Improved Grease Trap Standards*
- *6.5) Strengthen Current Animal Control Ordinances Relating to Removal and Disposal of Pet Wastes*
- *6.6) Implement Measures to Control Feral Cats, Rodents, and Nuisance Animals*
- *6.7) Develop a Program to Advise Television News Viewers of Bacteria Danger Levels in the Water*
- *6.8) Propose Access Restrictions to Bay Waters from City Parks and Other Bayfront City Properties During Periods of Public Health Risks*
- *6.9) Propose, Adopt and Enforce Additional Solid Waste Ordinances*
- *6.10) Explore Adoption of Additional LID Standards that will Reduce Stormwater Runoff from Areas of New Development or Significant Redevelopment*

## Technical Assistance for Management Measure 6.0

Technical assistance sources for Management Measure 6.0 include governmental, academic, and nonprofit entities with programs that support environmental education for the public, like those entities listed as Responsible Parties in each management measure activity.

## Financial Assistance for Management Measure 6.0

Financial assistance to implement Management Measure 6.0 may come from federal (EPA), state (TCEQ), and local governmental (City of Corpus Christi) and nonprofit entities. These programs include:

- **CWA Section 319(h) Grants:** EPA provides grant funding to Texas to implement the state's approved NPS Management Program and is administered by TCEQ and TSSWCB. The EPA-approved Texas program provides the framework for determining which activities are eligible for funding under CWA Section 319(h). In general, these activities include non-regulatory programs and are related to controlling NPS pollution. EPA-approved NPS programs cover costs associated with technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of specific NPS projects. (EPA, 2022)
- **Clean Water State Revolving Fund:** The Clean Water State Revolving Fund (CWSRF) program is a federal-state partnership that provides communities low-cost financing for a range of water quality infrastructure projects. The program functions as an environmental infrastructure bank by providing low-interest loans to eligible recipients for water infrastructure projects. Assistance can be provided for construction of publicly owned treatment works, decentralized wastewater treatment systems, and measures to manage, reduce, treat, or recapture stormwater or subsurface drainage water, among others.
- **Sewer Overflow and Stormwater Reuse Municipal Grants Program:** Grants are awarded to states, which then provide awards to eligible entities for projects that address infrastructure needs for SSOs and stormwater management.
- **Regional Solid Waste Grants Program:** TCEQ provides grants to regional councils of governments to fund solid waste management activities and various local and regional projects that help implement solid waste management plans.
- **Environmental Education Grants:** Under the Environmental Education Grants Program, EPA seeks grant proposals from eligible applicants to support environmental education projects that promote environmental stewardship and help develop knowledgeable and responsible students, teachers, and citizens. This grant program supplies financial support for projects that design, show, or teach environmental education practices, methods, or techniques as described in the Environmental Education Grant Program solicitation notices.
- **Coastal Bend Community Foundation Grants**: Donors in the Coastal Bend, through both current and testamentary gifts, have enabled the Foundation to enhance and improve the quality of life through grants to area nonprofit organizations. The Foundation's grants from unrestricted funds cover a broad spectrum of projects from the Arts to Zoology.
- **Urban Water Small Grants**: The objective of the Urban Waters Small Grants Program, administered by EPA, is to fund projects that will foster a comprehensive understanding of local urban water issues, identify and address these issues at the local level, and educate and empower the community. The Urban Waters Small Grants Program seeks to help restore and protect urban water quality and revitalize adjacent neighborhoods by engaging communities in activities that increase their connection to, understanding of, and stewardship of local urban waterways.

- **Coastal Management Program**: The Coastal Management (CMP), administered by NOAA and the TGLO, is a voluntary partnership between the federal government and U.S. Coastal and Great Lake states and territories. It is authorized by the Coastal Zone Management Act of 1972 to address national coastal issues. The Act provides funding for protecting, restoring, and responsibly developing our nation's diverse coastal communities and resources. To meet the goals of the Act, the National CMP takes a comprehensive approach to coastal resource management—balancing the often competing, and occasionally conflicting, demands of coastal resource use, economic development, and resource conservation. Some of the key elements of the National CMP include protecting natural resources, managing development in high hazard areas, giving development priority to coastal-dependent uses, providing public access for recreation, and coordinating state and federal actions.
- **Conservation Innovation Grant**: United States Department of Agriculture (USDA) Natural Resources Conservation Services' (NRCS) Conservation Innovation Grant (CIG) is a voluntary program intended to stimulate the development and adoption of innovative conservation approaches and technologies while leveraging federal investment in environmental enhancement and protection, in conjunction with agricultural production. Under CIG, Environmental Quality Incentives Program (EQIP) funds are used to award competitive grants to non-federal governmental or nongovernmental organizations, tribes, or individuals.
- **Conservation Stewardship Program - USDA NRCS**: The Conservation Stewardship Program **(**CSP) helps agricultural producers maintain and improve their existing conservation systems and adopt additional conservation activities to address priority resources concerns. Participants earn CSP payments for conservation performance—the higher the performance, the higher the payment.

## Management Measure Activity 6.1. Pre-Sale Inspection and Testing Program of Private Residential Sewer Laterals

The purpose of this management measure activity is to reduce or eliminate leaking or broken private sewer lines in the CARP watershed within 10 years of I-Plan approval.

Residential properties have been identified as a potential source of wastewater and other waste materials that could result in bacteria loadings. Old, leaking, broken, or improperly installed or maintained private wastewater sewer lines that allow wastewater to infiltrate into the stormwater conveyance system are a primary concern.

The major goal of this management measure activity is to establish a targeted inspection program to test private sewer lines within the CARP watershed to ensure they do not have any leaks or breaks, and to require, by law, repair of substandard private sewer lines, also known as private laterals. Lateral failures are often latent defects not seen until raw sewage reaches the surface or floods the interior of a home.

Sellers can mask such problems or fail to disclose this information. This is an appropriate requirement prior to a change of house ownership, to enable a new owner to be aware of failing plumbing. Often, plumbing problems are ignored after a purchase because the new owner is not aware of the issue or has no budget to fund expensive corrections. The current system allows "latent" defects to be passed on to a new owner. There is no leverage or requirement for plumbing inspections.

One option for funding is to propose a new ordinance for adoption with the necessary regulatory fees, to be charged to the seller for costs of inspections, identification of needed repairs, and needed lateral replacements, at rates designed to cover the total costs for the city to administer the program. The city could also explore options such as outside funding, tax abatement, or incentives programs to assist the city with program cost overrun, as well as seek grants to cover costs of pre-sale inspections, needed repairs, and lateral replacements, especially for low-income property owners. Private inspections of residential lateral lines, accompanying a sale, can likely be accomplished for under $100.00 to the parties involved, or for free if additional plumbing work is scheduled by a seller or buyer. The city would need to establish a disclosure filing fee to record inspection results associated with a sale. Inspection program would be conducted by licensed plumbers or other certified entities.

## Educational Component

The educational component of this management measure activity will include educating the public on the sewer lateral inspection/testing program through annual outreach events. Education on this topic will be an important aspect of this management measure since most homeowners are not aware that lateral lines could be leaking with no outward signs. Education and outreach will notify homeowners, and homebuyers, that lateral lines should be inspected, especially before a home purchase.

## Priority Areas

Priority areas for this management measure activity will be residences within the CARP watershed.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between the City of Corpus Christi, CARP stakeholders, academic (e.g., TAMUCC and TAMUK), nonprofit entities (e.g., CBBEP, AIA, CBBF) and professionals (such as licensed plumbers) as applicable, will be beneficial to implementing this management measure activity.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- the number of education and outreach events attended to educate the public on private sewer lateral lines,

- the number of meetings between CARP stakeholders and the city to discuss and possibly develop a new ordinance for adoption,
- establishing a targeted pre-sale inspection program for private sewer lines within the CARP watershed, and
- tracking the number of repairs and amount of sewer laterals replaced at residences.

## Monitoring Component

Ongoing coordination between the CARP stakeholders and the city will be tracked. Additionally, the number of illegal cross-connections identified vs. number of illegal cross-connections corrected, the number of pre-sale inspections, city code changes, and repaired and replaced private sewer lines as a result of the implementation of education and outreach and a pre-sale inspection program, will be tracked to measure progress. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

### Years 1-5:

- Include education on private sewer lateral lines at local education events.
- Coordinate with city staff, prepare, and present to the City of Corpus Christi Council new ordinances to establish a pre-sale inspection program of private sewer lines within the CARP watershed.
- If the new ordinance passes, the city will take appropriate enforcement action if property owners do not make necessary repairs to private sewer lines.
- Determine number of broken/leaking private sewer lines identified vs. number of broken/ leaking private sewer lines corrected.
- Provide five-year Management Measure Activity 6.1 progress report.

### Years 5-10:

- Re-evaluate progress made on repairing or replacing private sewer laterals after five years of implementation.
- Determine whether broken or leaking private wastewater lateral systems are providing a source of bacteria by infiltration into stormwater collection systems in the target basins, using the information obtained in the pilot program described in Management Measure Activity 5.1. Expand or maintain Management Measure Activity 6.1, as necessary.

## Estimated Load Reductions

Load reductions were not estimated for this management measure, however, reductions in bacteria may result from the implementation of a pre-sale inspection program to repair and replace leaking and broken private sewer lines in the CARP watershed.

**Table 29. Summary of CARP Management Measure Activity 6.1: Residential Leaking/ Broken Private Sewer Laterals Pre-Sale Inspection/Testing Program**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | Broken or leaking private sewer laterals |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance Needed** | Technical assistance sources would include governmental (e.g., EPA, TCEQ), academic (e.g., TAMUCC and TAMUK), and nonprofit entities (e.g., CBBEP, AIA, CBBF), and professionals such as licensed plumbers. Financial assistance may come from the City of Corpus Christi, any funding required beyond what the city budget allows may come from grants, ordinances, etc. |
| **Education Component** | Public will be educated on the importance of properly installed and maintained private sewer laterals and the potential inspection/testing program. |
| **Schedule of Implementation** | • **Years 1-5:** Include education on private sewer lateral lines at local education events. Coordinate with city staff, prepare, and present to the City of Corpus Christi Council new ordinances to establish a pre-sale inspection program of private sewer lines within the CARP watershed. If the new ordinance passes, the city will take appropriate enforcement action, if property owners do not make necessary repairs to private sewer lines. Determine number of broken/leaking private sewer lines identified vs. number of broken/ leaking private sewer lines corrected. Provide five-year Management Measure Activity 6.1 progress report.<br>• **Years 5-10:** Re-evaluate progress made on repairing or replacing private sewer laterals after five years of implementation. Determine whether broken or leaking private wastewater lateral systems are providing a source of bacteria by infiltration into stormwater collection systems in the target basins, using the information obtained in the pilot program described in Management Measure Activity 5.1. Expand or maintain Management Measure Activity 6.1, as necessary. |
| **Interim, Measurable Milestones** | • The number of education and outreach events attended to educate the public on private sewer lateral lines.<br>• The number of meetings between CARP stakeholders and the city to discuss and possibly develop a new ordinance for adoption.<br>• Establish a targeted pre-sale inspection program for private sewer lines, within the CARP watershed.<br>• Track the number of repairs and amount of sewer laterals replaced at residences. |
| **Monitoring Component** | **Programmatic:** Determine number of illegal cross-connections identified vs. number of illegal cross-connections corrected. Tracking the number of pre-sale inspections, city code changes, and repaired and replaced private sewer lines as a result of the implementation of the pre-sale inspection program. Five-year report. |
| **Responsible Parties** | CARP stakeholders should coordinate with the city to suggest the development of a pre-sale inspection and testing program. The City of Corpus Christi could propose and implement the program if an ordinance is passed. The city, CARP stakeholders, and the watershed coordinator could also incorporate education on properly installed and maintained private sewer laterals into educational events in the CARP watershed. |

## Management Measure Activity 6.2. Cross-Connections Inspection Program

The purpose of this management measure activity is to reduce or eliminate illegal commercial and residential cross-connections within the CARP watershed within 10 years of I-Plan approval.

Commercial and residential properties including multi-family rental property, single family residential units, retail establishments, industrial properties and others may be identified as sources of bacteria entering the watershed through cross-connections on their properties. The primary concerns involve illegal cross-connections between the private wastewater sewer lines on a given property that allow wastewater to infiltrate into the stormwater conveyance system.

CARP stakeholders suggest a review of the current construction codes and appropriate enforcement actions regarding sewer and stormwater laterals adopted in the City of Corpus Christi and other communities.

One option for funding is to propose a new ordinance for adoption with the necessary regulatory fees, to be charged to the customer for costs of inspections and removing cross-connections, at rates designed to cover the total costs to the city to administer the program. The city could also explore options such as outside funding, tax abatement, or incentives programs to assist with program cost overruns. Other financial assistance sources may include federal, state, and local government agencies with grants for wastewater infrastructure.

### Educational Component

The educational component of this management measure activity will inform the public, especially homeowners and commercial property owners, of cross-connections and the proposed Cross-Connection Inspection Program through an annual outreach event. Other potential avenues of outreach are through local chambers of commerce.

### Priority Areas

Priority areas for this management measure activity are commercial and residential properties in the CARP watershed.

### Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between the City of Corpus Christi, CARP stakeholders, local homeowners and commercial property owners, academic (e.g., TAMUCC and TAMUK), nonprofit entities (e.g., CBBEP, AIA, CBBF), and licensed plumbing professionals, as applicable, will be beneficial to implementing this management measure activity.

### Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- the number of homeowners and commercial property reached at the annual outreach event or other educational events,
- the number of meetings between CARP stakeholders and the city to review current ordinances and appropriate enforcement actions,
- the number of meetings between CARP stakeholders and the city to discuss and possibly develop a new ordinance or amendments for adoption,
- establishing a cross-connection inspection program within the CARP watershed to locate unauthorized cross-connections on residential and commercial property,
- the number of commercial sewer laterals inspected as a result of the city's expanded inspection programs, and
- the number of unauthorized cross-connections removed and locations where cross-connections were identified.

## Monitoring Component

Monitoring progress for this management measure activity will be tracked through ongoing coordination between CARP stakeholders and the city. Monitoring for this management measure may also be tracked through the following metrics: number of annual outreach events held, or other educational events attended, number of inspections, and number of cross-connections removed. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Years 1-5:**

- Plan and implement an annual outreach event.
- Complete a review of current construction codes and appropriate enforcement actions regarding sewer and stormwater laterals adopted in the City of Corpus Christi and other communities.
- Coordinate with city staff to identify codes that could be amended or new codes to be added.
- Coordinate with city staff to prepare and present to the City or Corpus Christi Council new ordinances to establish a Cross-Connection Inspection Program in the CARP watershed.
- If the new ordinance passes, develop, adopt, and execute an enhanced, targeted illegal cross-connections inspection program.
- Determine whether cross-connections between property sewer laterals and the city's stormwater collection system are providing a source of bacteria.
- Provide five-year Management Measure Activity 6.2 progress report.

**Years 5-10:**

- Continue cross-connection inspections, which may include smoke testing wastewater collection lines and stormwater lines.
- Re-evaluate progress made on commercial cross connection inspection after five years of implementation and expand or maintain implementation efforts, if necessary.

## Estimated Load Reductions

A load reduction has not been estimated for this management measure activity, however, reductions in bacteria may result from expanding the city's wastewater lateral inspection program, removing illegal cross-connections, and updating city code and ordinances.

**Table 30. Summary of CARP Management Measure Activity 6.2: Cross-Connections Inspection Program**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | Discharges from illegal cross connections |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance Needed** | Technical assistance sources would include governmental (e.g., EPA, TCEQ), academic (e.g., TAMUCC and TAMUK), nonprofit entities (e.g., CBBEP, AIA, CBBF), and licensed plumbing professionals. Financial assistance sources would be determined by the City of Corpus Christi, any funding required beyond what the city budget allows may come from grants, ordinances, etc. |
| **Education Component** | Educate the public especially homeowners and commercial property owners, on cross-connections and the proposed Cross-Connection Inspection Program. Other potential avenues of outreach are through local chambers of commerce. |
| **Schedule of Implementation** | • **Years 1-5:** Plan and implement an annual outreach event. Complete a review of current construction codes and appropriate enforcement actions regarding sewer and stormwater laterals adopted in the City of Corpus Christi and other communities. Coordinate with city staff to identify codes that could be amended or new codes to be added. Coordinate with city staff, prepare, and present to the City or Corpus Christi Council new ordinances to establish a Cross-Connection Inspection Program in the CARP watershed. If the new ordinance passes, develop, adopt, and execute an enhanced, targeted illegal cross-connections inspection program. Determine whether cross-connections between property sewer laterals and the city's stormwater collection system are providing a source of bacteria. Provide five-year Management Measure Activity 6.2 progress report.<br>• **Years 5-10:** Continue cross-connection inspections, which may include smoke testing wastewater collection lines and stormwater lines. Re-evaluate progress made on commercial cross connection inspection after five years of implementation and expand or maintain implementation efforts, if necessary. |

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|---|---|
| **Interim, Measurable Milestones** | • The number of commercial property owners or property managers reached at the annual outreach event or other educational events.<br>• The number of meetings between CARP stakeholders and the city to discuss and possible develop a new ordinance for adoption.<br>• Establish a cross-connection inspection program to locate unauthorized cross-connections on private commercial property.<br>• The number of commercial sewer laterals inspected as a result of the city's expanded inspection programs.<br>• The number of unauthorized cross-connections removed and commercial addresses where cross connections were identified. |
| **Monitoring Component** | **Programmatic:** Number of annual outreach events held, or events attended, number of sewer laterals inspected, and number of cross-connections removed. Five-year report. |
| **Responsible Parties** | City of Corpus Christi, CARP stakeholders, business owners, and property managers, if applicable |

## Management Measure Activity 6.3. Establishment of a Pilot Sewer Lateral Inspection and Testing Program for Commercial Property

The purpose of this management measure activity is to reduce or eliminate commercial leaking and/or broken sewer lines within the drainage basins that discharge to the CARP watershed.

Commercial properties have been identified as a potential source of cross-connections that could result in bacteria entering the city's MS4. The primary concerns involve old, leaking, broken, and improperly installed or maintained private sewer lines on the property.

This management measure activity seeks to establish a commercial inspection program to test private sewer lines to make sure they do not have any leaks or breaks, and mandate repair of substandard private sewer lines, also known as private laterals. The problem seems more prevalent in areas with older clay pipe, installed in the 1930s until 1950s, and with cast iron pipes, installed in 1960s and 1970s, all before widespread use of PVC piping.

There should be an evaluation of the adequacy of the city's current certificate of occupancy program to determine if changes in a property's infrastructure are being correctly installed and properly maintained, especially upon a change of ownership or a change in tenants. This might necessitate the adoption of a business permit system within the city.

A new ordinance could be proposed that would include the necessary regulatory fees, to be charged to the customer at rates designed to cover the program costs of inspections, identification of needed repairs, and needed lateral replacements. The city could explore outside options for funding, tax abatement, and incentives programs to assist the city with program costs.

## Educational Component

The educational component for this management measure activity will consist of educating public on the Commercial Sewer Lateral Inspection Program.

## Priority Areas

The priority area for this management measure activity will be the CARP watershed and any immediately adjoining drainage basins.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between the City of Corpus Christi, CARP stakeholders, local business owners and managers, academic, nonprofit entities (e.g., CBBEP), and licensed plumbing professionals, as applicable, will be beneficial to implementing this management measure activity.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- establish a cross-connection inspection program within the CARP watershed to locate broken or leaking sewer lines located on private commercial property,
- use the information obtained in the pilot program described in Management Measure Activity 6.1 to determine whether broken or leaking cross-connections between commercial property sewer laterals and the city's stormwater collection system are providing a source of bacteria within the CARP watershed,
- expand the city's current inspection programs within drainage basins contributing flows into the CARP watershed to locate broken or leaking sewer lines on commercial properties (this may include smoke testing wastewater and stormwater lines), and
- propose updates to the city's Technical Construction Codes and ordinances as they relate to the issue of commercial broken or leaking sewer lines.

## Monitoring Component

Monitoring progress for this management measure activity will be tracked through the number of broken and/or leaking private commercial sewer lines identified and corrected. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Years 1-5:**

- Propose to the City Council the approval and adoption of a leaking and broken commercial sewer inspection program.
- Complete a review of city's Technical Construction Codes and ordinances

- Determine whether broken or leaking commercial wastewater lateral systems are providing a source of bacteria by infiltration into stormwater collection systems in the target basins, using the information obtained in the pilot program described in Management Measure Activity 6.1.
- Establish a commercial inspection program to test private sewer lines for leaks or breaks, and mandate repair of substandard private sewer laterals especially upon a change of ownership and/or a change in tenants.
- Evaluate the city's current Certificate of Occupancy program to determine, if changes in a property's infrastructure are being correctly installed and properly maintained, especially upon a change of ownership and/or a change in tenants. This might necessitate the adoption of a business permit system within the city.
- Provide five-year Management Measure Activity 6.3 progress report.

## Estimated Load Reductions

A load reduction was not estimated for this management measure activity; however, a reduction of bacteria loading may result from an expanded wastewater lateral inspection program, identifying and repairing commercial sewer laterals, and completing a review and update of the city's building codes.

**Table 31. Summary of CARP Management Measure Activity 6.3: Establishment of a Pilot Sewer Lateral Inspection and Testing Program for Commercial Property**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | N/A |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance Needed** | Technical sources may be governmental (e.g., EPA, TCEQ), academic, nonprofit entities (e.g., CBBEP), and licensed plumbing professionals. Financial sources may include city regulatory fees, customer rates to cover inspections costs, and incentive programs. |
| **Education Component** | Educate public on the Commercial Sewer Lateral Inspection Program. |
| **Schedule of implementation** | **Years 1-5:** Propose to the City Council to consider the approval and adoption of a leaking and broken commercial sewer inspection program. Complete a review of city's construction codes and ordinances. Use pilot program information to determine if broken/leaking commercial wastewater lateral systems are a source of bacteria in stormwater collection systems. Establish a commercial inspection program. Test private sewer lines for leaks/breaks. Mandate repair of substandard private sewer lines (private laterals), especially upon change of ownership or tenants. Evaluate the city's certificate of occupancy program for necessary changes. Ensure property's infrastructure is correctly installed and maintained upon change of ownership and/or tenants. Provide five-year Management Measure Activity 6.3 progress report. |
| **Interim, Measurable Milestones** | • Establish a cross-connection inspection program within the CARP watershed to locate broken or leaking sewer lines located on private commercial property<br>• Use the information obtained in the pilot program described in Management Measure Activity 6.1 to determine whether broken or |

| | |
|---|---|
| | leaking cross-connections between commercial property sewer laterals and the city's stormwater collection system are providing a source of bacteria within the CARP watershed<br>• Expand the city's current inspection programs within drainage basins contributing flows into the CARP watershed to locate broken or leaking sewer lines on commercial properties.<br>• Propose updates to the city's Technical Construction Codes and ordinances as they relate to the issue of commercial broken or leaking sewer lines. |
| **Monitoring Component** | **Programmatic:** Track the number of broken/leaking private commercial sewer lines identified vs. number of broken/leaking private commercial sewer lines corrected. Five-year report. |
| **Responsible Parties** | Coordination between the City of Corpus Christi, CARP stakeholders, local business owners and managers, and other local stakeholders |

## Management Measure Activity 6.4. Improved Grease Trap Standards

The purpose of this management measure activity is to, within 10 years of I-Plan approval, reduce or eliminate undersized or malfunctioning grease interceptors or oil-water separators on commercial properties in the CARP watershed.

Clogged, overloaded grease and grit traps, and improperly operating oil-water separators may contribute to SSOs in the watershed which result in contaminated runoff entering the watershed. CARP stakeholders suggest that the standards for oil, grease, and grit traps in the city's current technical construction codes could be reviewed to verify they have adopted the best available technology and to adopt new standards for new and existing commercial properties. Existing installations should not be grandfathered if they fail to meet the current pre-treatment requirements. They should be afforded the opportunity to come into compliance with new requirements after a reasonable amortization period.

## Educational Component

The educational component of this management measure activity will include notifying the public, especially business owners or managers, on the importance of identifying undersized or malfunctioning grease interceptors or oil-water separators and of any new grease trap standards. Additionally, at least one outreach event per year will be held to notify commercial real estate owners, landlords and property managers of the importance of grease trap maintenance.

## Priority Areas

The priority area for this management measure activity will be the CARP watershed.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between the City of Corpus Christi, CARP stakeholders, academic, nonprofit entities (e.g., CBBEP), and licensed plumbing professionals, as applicable will be beneficial to implementing this management measure activity.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- the number of meetings between CARP stakeholders and the city to discuss an ordinance review and possible improvements,
- conduct at least one educational outreach activity per year,
- complete a review of the city's technical construction codes related to grease traps, grit traps, and oil-water separators,
- improve grease trap, grit trap, and oil-water separator inspection program, if needed, and
- adopt new standards for new and existing commercial properties, including best available technology.

## Monitoring Component

Monitoring progress for this management measure activity will be tracked through ongoing coordination between CARP stakeholders and the city. Monitoring for this management measure activity may also be done by tracking and comparing the number of grease traps, grit traps, and oil/water separators that do not operate at appropriate levels and the number that are repaired or replaced. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Years 1-5:**

- Conduct an annual education and outreach activity.
- Coordinate with city staff, review and possibly improve of city's technical construction codes.
- Adopt new standards for construction code updates related to grease and grit traps, and oil-water separators which include best available technology.
- Continue and improve the city's grease trap, grit trap, and oil-water separator inspection program.
- Provide five-year Management Measure Activity 6.4 progress report.

**Years 5-10:**

- After five years of implementation, re-evaluate progress made on improved grease traps standards. Expand or maintain implementation efforts as necessary.

## Estimated Load Reductions

A load reduction estimate was not calculated for this management measure activity; however, a potential bacteria reduction may occur as a result of updating the city's construction codes and inspection program.

**Table 32. Summary of CARP Management Measure Activity 6.4: Improved Grease Trap Standards**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | SSOs associated with FOG |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance Needed** | Technical assistance may include governmental (e.g., EPA, TCEQ), academic, nonprofit entities (e.g., CBBEP), and licensed plumbing professions. Financial assistance sources would be determined by the City of Corpus Christi, any funding required beyond what the city budget allows may come from grants, ordinances, etc. |
| **Education Component** | Notify the public of new grease trap standards. Conduct at least one outreach event per year notifying commercial real estate owners, landlords, and property managers of the importance of grease trap maintenance. |
| **Schedule of Implementation** | • **Years 1-5:** Conduct an annual education and outreach activity. Coordinate with city staff to review and possibly improve the city's technical construction codes. Adopt new standards for construction codes updates, including best available technology. Continue and improve grease trap, grit trap, and oil/water separator inspection program. Provide five-year Management Measure Activity 6.4 progress report.<br>• **Years 5-10:** After five years of implementation, re-evaluate progress made on improved grease traps standards. |
| **Interim, Measurable Milestones** | • The number of meetings between CARP stakeholders and the city to discuss an ordinance review and possible improvements.<br>• Conduct at least one educational outreach activity per year.<br>• Complete a review of the city's technical construction codes related to grease traps, grit traps, and oil/water separators.<br>• Continue and improve grease trap, grit trap, and oil/water separator inspection program.<br>• Adopt best available technology. |
| **Monitoring Component** | **Programmatic**: Track the number of educational outreach activities completed. Track and compare the number of grease traps, grit traps, and oil-water separators that do not operate at appropriate levels. and the number repaired or replaced. Five-year report. |
| **Responsible Parties** | City of Corpus Christi, CARP stakeholders, business owners, and managers, if applicable. |

## Management Measure Activity 6.5. Strengthen Current Animal Control Ordinances Relating to Removal and Disposal of Pet Wastes

The purpose of this management measure activity is to reduce the amount of pet waste running off private and public property.

CARP stakeholders should coordinate with city staff to propose a review of animal control ordinances adopted in other communities, draft appropriate proposed amendments to the Code of Ordinances, submit the proposal to the city's Animal Control Board for review and recommendation, and refer to City Council for adoption. Amendments should strengthen current ordinances that require pet owners to remove and properly dispose of pet wastes, such as the "pooper scooper" requirements and the requirement to remove waste that has accumulated on the ground from animals

that are harbored on the property. This should also apply to free range chickens and livestock that are not related to a commercial agriculture operation. Ordinance amendments would include, at a minimum, new enforcement measures, stricter fines, and enhancements to improve enforceability.

The city's police department, as well as code compliance department, should be engaged in animal waste control enforcement. Officers on bicycles are optimal contacts to warn the public of applicable animal waste obligations and disseminate education and outreach materials. Police department engagement will require a policy shift. A possible source of funding would be to adopt an ordinance that would include a regulatory fee charged to ordinance violators at a rate designed to cover the total costs to the city to administer the program.

## Educational Component

Educating the public on the importance of properly disposing of pet waste is included in Management Measure Activity 1.3. This activity will educate the public on current animal control ordinances and potential proposed amendments. Additionally, at least one outreach event or educational pamphlet should be held or developed per year to help residents understand the animal control ordinances.

## Priority Areas

The priority area for this management measure activity is the CARP watershed.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between the City of Corpus Christi, CARP stakeholders, and other local stakeholders, as applicable will be beneficial to implementing this management measure activity.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- the number of meetings between CARP stakeholders and the city to discuss the animal control ordinances and possible amendments,
- conduct at least one educational outreach activity per year,
- the number of animal control ordinances reviewed in other communities relating to pet waste,
- the number of amendments to existing city ordinances drafted related to controlling pet waste, and
- making pet waste enforcement a policy priority, or at least a function, within the city's animal control which is a part of the city's police department (not limited to code compliance department).

## Monitoring Component

Monitoring progress for this management measure activity will be tracked through ongoing coordination between CARP stakeholders and the city. Monitoring for this management measure activity may also be done through the number of complaints investigated and the number of enforcement actions taken (includes issuance of warnings, notices of violation, and citations). A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Years 1-5:**

- Conduct at least one educational outreach activity per year.
- Coordinate with city staff to propose a review and possibly amend the animal control ordinances.
- Draft proposed amendments to city's animal control ordinance related to pet waste.
- Complete ordinance review and submit proposal to the city's Animal Control Board for review and refer to City Council for adoption.
- Provide five-year Management Measure Activity 6.5 progress report.

## Estimated Load Reductions

The load reduction from pet waste management was estimated in Management Measure Activity 1.3.

**Table 33. Summary of CARP Management Measure Activity 6.5: Strengthen Current Animal Control Ordinances Relating to Removal and Disposal of Pet Wastes**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | Improper disposal of pet waste. |
| **Potential Load Reduction** | Calculated in Management Measure Activity 1.3 |
| **Technical and Financial Assistance Needed** | Technical assistance may be given via government, academic and nonprofit entities. Financial assistance to City of Corpus Christi has yet to be determined. A possible source of revenue may come from regulatory fees for code violations. |
| **Education Component** | Educate public on new animal control ordinances. Conduct at least one outreach event or educational pamphlet per year to help residents understand the animal control ordinances. |
| **Schedule of Implementation** | **Years 1-5:** Conduct at least one educational outreach activity per year. Review animal ordinances in other communities. Draft proposed animal control ordinance related to pet waste. Complete ordinance review and submit proposal to the city's Animal Control Board for review and refer to City Council for adoption. Provide five-year Management Measure Activity 6.5 progress report. |
| **Interim, Measurable Milestones** | • The number of meetings between CARP stakeholders and the city to discuss the animal control ordinances and possible amendments.<br>• Conduct at least one educational outreach activity per year. |

| | |
|---|---|
| | • Number of animal control ordinances reviewed in other communities.<br>• Number of amendments to existing city ordinances drafted related to controlling pet waste.<br>• Making pet waste enforcement a policy priority, or at least a function, within the city's animal control which is a part of the city's police department. |
| **Monitoring Component** | **Programmatic:** Track the number of complaints investigated and the number of enforcement actions taken (includes issuance of warnings, notices of violation, and citations). Five-year report. |
| **Responsible Parties** | City of Corpus Christi, CARP stakeholders, pet owners, and others as applicable |

## Management Measure Activity 6.6. Implement Measures to Control Feral Cats, Rodents, and Nuisance Animals

The purpose of this management measure activity is to reduce the amount of animal waste from feral cats, rodents, and nuisance animals, such as possums, that reside on public and private property.

CARP stakeholders will coordinate with city staff to propose a review of animal control ordinances adopted in other communities, draft appropriate proposed amendments to the Code of Ordinances, submit the proposal to the city's Animal Control Board for review and recommendation, and refer to the City of Corpus Christi Council for adoption. A possible source of funding would be to adopt an ordinance that would include the necessary regulatory fees, to be charged to the customer for costs of any inspections and code enforcement costs, at rates designed to cover the total costs to the city to administer the program.

Coastal Bend Cat Rescue (CBCR) helps the City of Corpus Christi by implementing a Trap-Neuter-Return (TNR) program that reduces the number of feral cats. These programs work with citizens and volunteers to trap feral cats, spay or neuter them, mark them, and release them back into the same area. This is seen as a humane way to reduce feral cat populations and their effects on the ecosystem and water quality.

## Education Component

The educational component of this management measure activity will include educating the public on how they can help control pet waste associated with feral cats, rodents, and nuisance animals.

## Priority Areas

The priority area for this management measure activity is the CARP watershed.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between the City of Corpus Christi, CARP stakeholders, academic entities and other local stakeholders, such as CBCR, will be beneficial to implementing this management measure activity.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- the number of meetings between CARP stakeholders and the city to discuss the animal control ordinances and possible amendments,
- the number of animal control ordinances in other communities reviewed,
- the number of amendments to existing City of Corpus Christi ordinances drafted and presented, and
- the number of TNR events and animal waste education and outreach activities completed.

## Monitoring Component

Monitoring progress for this management measure activity will be tracked through ongoing coordination between CARP stakeholders and the city. Monitoring for this management measure activity may also be done through the number of amendments proposed to the Animal Control Board City Council and the number of TNR events held. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Years 1-5:**

- Coordinate with city staff to propose a review and possibly amend the animal control ordinances.
- Draft appropriate proposed amendments to the Code of Ordinances.
- Submit the proposal to the city's Animal Control Board for review and recommendation.
- Refer to City Council for adoption.
- Continue conducting TNR events and education and outreach.
- Provide five-year Management Measure Activity 6.6 progress report.

## Estimated Load Reductions

An estimated load reduction was not calculated for this management measure activity, however amendments to existing animal control ordinances to better control pet waste may lead to an overall reduction in bacteria.

**Table 34. Summary of CARP Management Measure Activity 6.6: Implement Measures to Control Feral Cats, Rodents and Nuisance Animals**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | Waste from feral cats, rodents, and nuisance animals |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance Needed** | Technical and financial assistance sources would include governmental, academic, and nonprofit entities. A possible source of revenue may come from regulatory fees for code violations. |

| | |
|---|---|
| **Education Component** | Educate the public on measures they could use to help control feral cats, rodents, and nuisance animals. |
| **Schedule of Implementation** | **Years 1-5:** Coordinate with city staff to propose a review and possibly amend animal control ordinances. Draft appropriate proposed amendments to the Code of Ordinances. Submit the proposal to the city's Animal Control Board for review and recommendation. Refer to City Council for adoption. Continue conducting TNR events and education and outreach. Provide five-year Management Measure Activity 6.6 progress report. |
| **Interim, Measurable Milestones** | • Number of meetings between CARP stakeholders and the city to discuss the animal control ordinances and possible amendments.<br>• Number of animal control ordinances in other communities reviewed.<br>• Number of amendments to existing City of Corpus Christi ordinances drafted and presented.<br>• Number of TNR events and education outreach activities completed. |
| **Monitoring Component** | **Programmatic:** Ongoing coordination between CARP stakeholders and the city will be tracked as well as the number of amendments proposed to the Animal Control Board City Council and the number of TNR events held. Five-year report. |
| **Responsible Parties** | City of Corpus Christi and CARP stakeholders, other local stakeholders, such as CBCR. |

## Management Measure Activity 6.7. Develop a Program to Advise Television News Viewers of Bacteria Danger Levels in the Water

The purpose of this management measure activity is to reduce public health risks associated with recreational use of Corpus Christi Bay adjacent to the City of Corpus Christi's stormwater outfalls during rain events when bacteria may be elevated.

Until implementation efforts effectively reduce elevated bacteria levels associated with rain events, this management measure activity seeks to propose an ordinance to the City of Corpus to establish a protocol to notify the public of potential elevated bacteria levels before, during, and after rain events. Notification of potential rain events will ideally come from interactive and predictive radar weather forecasts from weather stations located in the immediate area. An advertisement protocol could also be established after rain events when elevated bacteria levels have fallen to permissible levels.

The goal of the education and outreach of this management measure is to conduct a program similar the JeSani Smith Foundation's[17] programs, which warn the public of dangerous rip currents that can occur on Texas beaches. This program's goal will be to inform the public of elevated bacteria levels after a rain event, in hopes to prevent illness in recreational users.

[17] https://www.jesanismithfoundation.org/

## Education Component

Public health safety advisories are issued as directed in the proposed ordinance to the public. The advisories will help to educate the public about how stormwater runoff from rain events affect the bacteria levels in the bay.

## Priority Areas

The priority area for this management measure activity will be the CARP watershed.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between the City of Corpus Christi, CARP stakeholders, local weather stations and meteorologists, federal government agencies (such as EPA and NOAA), state agencies (such as TGLO) and local governments (such as the City of Corpus Christi and CBCOG), academic institutions (such as TAMUCC Harte Research Institute), nonprofit organizations (such as CBBEP, CBBF, and Surfrider Foundation) with programs that support environmental education for the public, will be beneficial to implementing this management measure activity.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- coordination between CARP stakeholders and city staff to prepare and present an ordinance about issuing general and specific public health safety advisories on recreational use of Corpus Christi Bay waters with elevated bacteria levels following major rain events,
- ordinance adoption by City of Corpus Christi Council, and
- the number of public health and safety advisories issued as a result off the adoption of the ordinance.

## Monitoring Component

Programmatic monitoring of the implementation of this management measure activity will consist of tracking the number of public health advisories issued as a result of the adoption of the ordinance. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Year 1:**

- Draft a proposed ordinance for issuing general and specific public health and safety advisories for contact recreational use of Corpus Christi Bay waters when bacteria levels are elevated.

**Year 2:**

- Present the proposed city ordinances to the City of Corpus Christi Council that would devise an advisement protocol to inform the public of elevated bacteria levels due to wet weather events that could lead to periodic higher bacteria levels.

**Years 3-4:**

- If ordinances are adopted, implement the new ordinances to mitigate human risk from contact recreation in beaches during elevated bacteria events due to rain events.

**Year 5:**

- Evaluate how many public health safety advisories were issued as directed in the ordinances.
- Provide five-year Management Measure Activity 6.7 progress report.

## Estimated Load Reductions

Load reduction calculations were not calculated for this management measure activity due to this management measure activity only planning implementation for outreach and education events...

**Table 35. Summary of CARP Management Measure Activity 6.7: Develop a Program to Advise Television News Viewers of Bacteria Danger Levels in the Water**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | N/A |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance Needed** | Technical and financial assistance sources would include governmental, academic, and nonprofit entities with programs, grants and funding that support environmental education |
| **Education Component** | Public health safety advisories are issued as directed in the proposed ordinance. |
| **Schedule of Implementation** | • **Year 1:** Draft a proposed ordinance for issuing general and specific public health and safety advisories for contact recreational use of Corpus Christi Bay waters when bacteria levels are elevated.<br>• **Year 2:** Present the proposed ordinance to the City of Corpus Christi Council that would devise an advisement protocol to inform the public of elevated bacteria levels due to wet weather events that could lead to periodic higher bacteria levels.<br>• **Years 3-4:** If ordinances are adopted, implement the new ordinances to mitigate human risk from contact recreation in the watersheds during elevated bacteria due to rain events.<br>• **Year 5:** Evaluate how many public health safety advisories were issued as directed in the ordinances. Provide five-year Management Measure Activity 6.7 progress report. |
| **Interim, Measurable Milestones** | • CARP stakeholders will coordinate with city staff to prepare and present an ordinance about issuing general and specific public |

| | |
|---|---|
| | safety advisories on recreational use of Corpus Christi Bay waters with elevated bacteria levels following major rain events.<br>• Ordinance adoption by the City of Corpus Christi Council.<br>• Track the number of public health and safety advisories issued as a result of the adoption of the ordinance. |
| **Monitoring Component** | **Programmatic:** Monitoring of the implementation of this management measure activity will consist of tracking the number of public health safety advisories issued as a result of the adoption of the ordinance. Five-year report. |
| **Responsible Parties** | City of Corpus Christi, CARP stakeholders, and other local stakeholders, if applicable. |

## Management Measure Activity 6.8. Propose Access Restrictions to Bay Waters from City Parks and Other Bayfront City Properties During Periods of Public Health Risks

The purpose of this management measure activity is to reduce public health risks associated with recreational use of Corpus Christi Bay waters adjacent to the City of Corpus Christi's stormwater outfalls which have excessive bacteria levels during and immediately following heavy rain events.

Until implementation efforts effectively reduce elevated bacteria levels associated with rain events, CARP stakeholders recommend preparing and presenting an ordinance for adoption to the City of Corpus Christi Council that authorizes the City Manager to close or deny direct access to recreational waters from city parks and public spaces during periods when there is an increased risk to public health from elevated bacteria levels in Corpus Christi Bay. This ordinance proposal will be held in active abeyance during the first years of the I-Plan approval and implementation. During this abeyance period, recognized stakeholder work groups (Ordinances/Regulations, Education/Outreach, and Monitoring/Research) will meet to create specific language or elements for a proposed ordinance to restrict access pertaining to the subject beaches during periods of risk to public health and safety. The goal of the ordinance will be to regulate or manage beach access during periods of risk to public health or safety. The work groups will explore conditions and progress made under the I-Plan that may affect the efficacy and appropriateness of a beach access ordinance.

Elements for work group consideration include, but are not limited to:

- creation of an exempted class of recreational user,
- the use/non-use of the city's police powers in managing access,
- potential for penalties and non-penal approaches to enforcement (education and outreach in lieu of enforcement or to supplement enforcement),
- progress or new approaches to testing and evaluation of bacteria in recreational waters in the watersheds, and
- any legal and scientific avenues appropriate to managing access to affected beaches for the benefit of public health and safety.

The participating work groups will, at their discretion, recommend a proposed draft ordinance to the CARP stakeholders for further action, which the committee may incorporate as an adjunct to the current I-Plan. At any time, CARP stakeholders may deem it appropriate to accept or decline the proposal. The draft ordinance will include language to exempt the following recreational activities: windsurfing, sailboarding, and kiteboarding. This subset of recreational users relies upon the launch site at Oleander Point within Cole Park. However, users will be informed about the assumption of risk associated with contact with bay waters.

## Education Component

The educational component of this management measure will consist of notifying the public of new proposed restrictions when bacteria levels could pose a health risk. Education will also be provided to the public through information about the safety and health risks for recreating in impaired bay waters. At the Oleander Point launch site in Cole Park, exempted recreational users will be informed of assumption of risk.

## Priority Areas

The priority area for this management measure activity will be Cole Park and Ropes Park.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between the City of Corpus Christi, CARP work groups, local non-profit organizations (e.g., CBBEP) and other local stakeholders as applicable, will be beneficial to implementing this management measure activity.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- draft and propose ordinance for adoption,
- adopt ordinance within five years,
- track monitoring data collected by the TGLO, and
- reduce public health risks by restricting public access of bay waters adjacent to city stormwater outfalls immediately following heavy rain events.

## Monitoring Component

Programmatic monitoring of the implementation of this measurement measure activity will consist of tracking work group meetings held to develop draft ordinance language and coordination between CARP stakeholders and city staff. Monitoring data collected by the TGLO to determine when beach access needs to be restricted to the public will also be tracked. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Year 1:**

- Prepare and present to Council for adoption an ordinance that authorizes the City Manager to close or deny contact access to recreational waters from city parks and public spaces during periods when there is a risk to public health from elevated bacteria levels in the bay.

**Years 2-5:**

- Adopt an ordinance to authorize the City Manager to close or deny contact access to recreational waters from city parks and public spaces during periods when there is a risk to public health from elevated bacteria levels in the bay. Closure or denial of access would be accomplished by posting appropriate signage and installing barriers on physical access points, such as steps or pathways.

- Provide five-year Management Measure Activity 6.8 progress report.

## Estimated Load Reductions

Load reduction calculations were not calculated for this management measure activity due to this measure implementing safety precautions only.

**Table 36. Summary of CARP Management Measure Activity 6.8: Restrict Access to Bay Waters from City Parks and Other Bay Front City Properties During Periods of Significant Public Health Risks**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | N/A |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance Needed** | Technical and financial assistance sources would include government, academic, and nonprofit entities with programs, grants, and funding that support environmental education. |
| **Education Component** | Notify the public of new proposed beach and water restrictions when bacteria levels are or can be a health risk. |
| **Schedule of Implementation** | • **Year 1:** Prepare and present to Council for adoption an ordinance that authorizes the City Manager to close or deny contact access to recreational waters.<br>• **Years 2-5:** Adopt ordinance to authorize the City Manager to close or deny access to bay waters for contact recreation from city parks and public spaces during periods when there is a significant public health risk. Closure or denial of access would be accomplished by posting appropriate signage and installing barriers on physical access points, such as steps or pathways. Provide five-year Management Measure Activity 6.8 progress report. |
| **Interim, Measurable Milestones** | • Draft ordinance and propose for adoption.<br>• Adopt ordinance within five years.<br>• Track monitoring data collected by the TGLO. |

| | |
|---|---|
| | • Reduce public health risks by restricting public access of bay waters adjacent to City stormwater outfalls, immediately following heavy rain events. |
| **Monitoring Component** | **Programmatic:** Implementation progress for this management measure will be tracked through the number of work group meetings held to develop draft ordinance language and coordination between CARP stakeholders and city staff. Five-year report. |
| **Responsible Parties** | City of Corpus Christi, CARP stakeholders, and other local stakeholders as applicable |

## Management Measure Activity 6.9. Propose, Adopt and Enforce Additional Solid Waste Ordinances

The purpose of this management measure activity is to reduce the volume of solid waste that runoff or blow into the watershed from commercial properties. Solid waste, especially litter that contains or was associated with food can contribute to the growth of bacteria within the stormwater system. While the city currently has ordinances to address litter at food establishments, the current ordinances do not provide requirements related to the number and maintenance of outdoor trash receptacles in commercial parking lots and public access areas. CARP stakeholders will coordinate with city staff to review current ordinances, research ordinances adopted in other communities, and draft new and amended ordinances to propose to the City of Corpus Christi City Council. A possible source of funding would be to adopt an ordinance that would include the levying of fines and regulatory fees associated with the adoption of a new or improved upon ordinance. The proposed new and amended ordinances should provide:

- Increase the required number of waste receptacles on commercial properties and public areas.
- Enhance a commercial owner's maintenance obligations to service waste receptacles and clear parking lots of loose debris, particularly, discarded used diapers and animal carcasses, with special attention to dead birds and discarded food that attracts birds.
- Enhanced ordinance obligations requiring contractors who provide dumpsters to keep dumpster areas free of deleterious materials and leakage.
- Support the current efforts to reduce plastic bag usage.
- Updated and enforceable secondary containment requirements for customers of waste disposal services. Standards would require trash to be placed in plastic and paper container bags. Enforcement of secondary containment puts the citizen/customer in a more responsible position to assist the city in controlling fugitive wastes.

## Education Component

The educational component of this management measure activity will use media outlets and public notifications to educate the community on the impacts of solid waste and how an ordinance could help prevent this waste from entering the watershed. Flyers will be distributed in utility bills, asking customers to contain all loose trash in plastic bags before disposing it in trash cans.

The public will also be notified of the proposed new or amended ordinances.

## Priority Areas

The priority area for this management measure activity will be the CARP watershed.

## Responsible Parties and Funding

The organizations listed below will be responsible only for expenses associated with its own efforts. Coordination between the City of Corpus Christi, CARP stakeholders, local governmental agencies (such as EPA and CBCOG) and other local stakeholders as applicable, will be beneficial to implementing this management measure activity. Costs to the City of Corpus Christi are to be determined. A possible source of funding would be to adopt an ordinance that would include the necessary regulatory fees, to be charged to the customer for costs of any inspections and code enforcement costs, at rates designed to cover the total costs to the city to administer the program.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- the number of meetings and amount of coordination between CARP stakeholders and city staff,
- the number of reviewed litter and property maintenance ordinances previously adopted in Corpus Christi and other communities,
- the number of drafted proposed amendments relating to containment of solid waste in commercial properties to the city's Code of Ordinances,
- submittal of the proposal to the City Council for adoption, and
- the number of flyers sent out asking trash customers to contain loose trash in trash bags before disposing in trash cans.

## Monitoring Component

The programmatic implementation progress of this management measure activity will be tracked through the meetings held to develop draft ordinance language and coordination between CARP stakeholders and city staff. The notification of new ordinances and the importance of solid waste management can also be tracked through the distribution of flyers and other notification methods. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

# Implementation Schedule

**Years 1-2:**

- Research on current ordinances adopted in Corpus Christi and other communities will be conducted.
- Draft new ordinances and appropriate amendments, as needed, to the Code of Ordinances and propose them for adoption.

**Years 3-5:**

- If ordinances or amendments are adopted, the public will be notified through media outlets.
- The city and other responsible parties will distribute flyers in utility bills, asking customers to contain all loose trash in plastic bags before disposing it in trash cans.
- Provide five-year Management Measure Activity 6.9 progress report.

# Estimated Load Reductions

Load reduction calculations are not applicable to this management measure activity due to this management measure only planning prevention measures.

**Table 37. Summary of CARP Management Measure Activity 6.9: Propose, Adopt and Enforce Additional Solid Waste Ordinances**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | N/A |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance** | Technical and financial assistance sources would include federal, state, and local governmental agencies (such as EPA, TCEQ, City of Corpus Christi, CBCOG and others). |
| **Educational Component** | Use media outlets and public notification to educate the community on the impacts of solid waste and how an ordinance could help prevent this waste from entering the watershed. Notify public of the proposed new ordinances. |
| **Schedule of Implementation** | • **Years 1-2**: Research on current ordinances adopted in Corpus Christi and other communities, draft new ordinances and appropriate amendments to the Code of Ordinances and propose them for adoption.<br>• **Years 3-5**: If ordinances or amendments are adopted, the public will be notified through media outlets. Distribute flyers in utility bills, asking customer to contain all loose trash in plastic bags before disposing it in trash cans. Provide five-year Management Measure Activity 6.9 progress report. |
| **Interim, Measurable Milestones** | • Meetings and coordination between CARP stakeholders and city staff.<br>• Review litter and property maintenance ordinances previously adopted in Corpus Christi and other communities.<br>• Draft new ordinances and appropriate proposed amendments to the Code of Ordinances.<br>• Submit the proposal to the City Council for adoption.<br>• Number of flyers sent out asking trash customers to contain loose trash in trash bags before disposing in trash cans. |

| | |
|---|---|
| **Monitoring Component** | **Programmatic:** Meetings held to develop draft ordinance language and coordination between CARP stakeholders and city staff. Flyers and other notification of the public on new ordinances and the importance of solid waste management. Five-year report. |
| **Responsible Parties** | CARP stakeholders, the City of Corpus Christi, and other local stakeholders as applicable |

## Management Measure Activity 6.10: Explore Adoption of Additional LID Standards that will Reduce Stormwater Runoff from Areas of New Development or Significant Redevelopment

The purpose of this management measure activity is to reduce the volume of stormwater runoff from commercial properties through additional LID standard implementation. This management measure activity serves to review LID standards adopted by other communities that reduce stormwater runoff from areas of new development or significant redevelopment. While the city currently has some ordinances that designate LID standards in the Unified Development Code (UDC), additional LID standards could more efficiently slow the flow of stormwater runoff within new developments and areas that are undergoing redevelopment.

Common LID practices that have shown to slow the flow of stormwater runoff for new or redeveloped land include the installation of parking lot swales, bioretention gardens, permeable asphalt, etc. This management measure activity will develop a special advisory committee to study issues and make LID recommendations to the Planning Commission and City Council for amendments to the UDC. The committee should have broad public membership and include developers, residential and commercial builders, consulting engineers, neighborhood homeowner association representatives, and environmental interests.

## Education Component

Management Measure Activity 1.5 will provide “Slow the Flow” training workshops targeted at local building association, engineering firms, architect and landscape design groups, and other design community members the demonstrating LID techniques and their benefits to the watershed. This management measure activity will educate the builders, developers, and the public on LID standards in the UDC and promote LID in the UDC by demonstrating the benefits through social media and educational presentations.

## Priority Areas

The priority area for this management measure activity will be the CARP watershed.

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between the City of Corpus Christi, CARP stakeholders, AIA,

CBCOG, CBBEP and other local stakeholders as applicable, will be beneficial to implementing this management measure activity.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- to establish a special advisory committee to study issues and make recommendations to the Planning Commission and City Council for amendments to the UDC,
- the number of reviewed LID ordinances adopted in Corpus Christi and other communities,
- the number of new LID standards drafted,
- submittal of the new standards to the Planning Commission and City Council for adoption, and
- adoption of ordinances regarding LID and the reduction of stormwater runoff.

## Monitoring Component

The programmatic implementation progress of this management measure activity will be tracked through the establishment of the advisory committee, meetings held to develop draft ordinance language, coordination between the advisory committee and city staff, and the amount of LID techniques used by new developments if the ordinances are adopted. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure activity.

## Implementation Schedule

**Year 1:**

- Educate public of LID benefits and its standards in the city's UDC.
- Develop an advisory committee to develop UDC amendment recommendations encouraging LID in new developments and other building projects in the city.
- Set public education and campaign goals.

**Year 2:**

- Work with the local government, developers, builders, engineers, and the public to amend the UDC to encourage LID.

**Years 3-5:**

- Continue LID education and campaigns as determined from goals set in Year 1.
- Continue effort to amend the UDC if necessary.
- Provide five-year Management Measure Activity 6.10 progress report.

## Estimated Load Reductions

Implementation of the Slow the Flow (LID) Initiative, through the adoption of LID standards could lead to load reductions in the CARP watershed.

According to existing studies on how LID affects bacterial load reductions, an estimated bacteria reduction of up to 81.5% in the area of the watershed that implements LID techniques is possible (Rippy, 2015). If at least 50 acres in the CARP watershed were to adopt LID techniques due to the implementation of LID standards by the city, there could be a potential reduction in bacteria loadings to the watershed of 16.16 billion cfu/year of Enterococci.

$$Load_{LID} = UA_{LID} \times ALR_{LID} \times UR_{LID} \times Conversion$$

Where:

$Load_{LID}$= estimated load reduction from implementation of LID standards, 16.16 billion cfu/year.

$UA_{LID}$= 50 acres, urban acreage that implements LID techniques.

$ALR_{LID}$ = 81.5%, average load reduction of LID techniques (Rippy, 2015).

$UR_{LID}$ = 2.27 billion cfu/acre/year, average urban runoff loading.

$Conversion$= .175, Fecal coliform to Enterococci conversion rate.

**Table 38. Summary of CARP Management Measure Activity 6.10: Explore Adoption of Additional LID Standards that will Reduce Stormwater Runoff from Areas of New Development or Significant Redevelopment**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | Urban stormwater runoff |
| **Potential Load Reduction** | 16.16 billion cfu/year |
| **Technical and Financial Assistance Needed** | Technical and financial assistance sources would include governmental, academic, and nonprofit entities with programs, grants, and funding that support LID and environmental education, including anti-littering. |
| **Education Component** | Educate builders, developers, and the public on LID standards in the UDC and promote LID in the UDC by demonstrating the benefits via social media and educational presentations. |
| **Schedule of Implementation** | • **Year 1:** Educate public on LID benefits and its standards in the city's UDC. Develop an advisory committee to develop UDC amendment recommendations encouraging LID in new developments and other building projects in the city. Set public education and campaign goals.<br>• **Year 2:** Work with the local government, developers, builders, engineers and the public to amend the UDC to encourage LID.<br>• **Years 3-5:** Continue LID education and campaigns as determined from goals set in Year 1. Continue effort to amend the UDC if necessary. |
| **Interim, Measurable Milestones** | • Establish special advisory committee.<br>• Review LID ordinances adopted in Corpus Christi and other communities.<br>• Draft new LID standards and submit them to the Planning Commission and City Council for adoption.<br>• Adoption of the ordinances |

| | |
|---|---|
| **Monitoring Component** | **Programmatic:** The establishment of the advisory committee, meetings held to develop draft ordinance language, and coordination between the advisory committee and city staff will be tracked to monitor progress. If the ordinances are adopted, the amount of LID techniques used by new developments will also be tracked. Five-year report. |
| **Responsible Parties** | City of Corpus Christi, CARP stakeholders, AIA, and other local stakeholders as applicable. |

# Oso Bay and Oso Creek Management Measures

There are nine management measures for the Oso watershed.

### Oso Management Measures

1) *Identify OSSFs, Prioritize Problem Areas, and Systematically Work to Bring Systems into Compliance*
2) *Promote, Develop, and Implement Conservation Plans, Water Quality Management Plans, and Wildlife Habitat Plans*
3) *Promote the Management of Feral Hog Populations*
4) *Promote the Reduction of Illicit Dumping and Proper Disposal of Animal Carcasses*
5) *Improve Wastewater Collection and Treatment Systems*
6) *Promote the Proper Management of Pet Waste*
7) *Promote, Develop, and Implement Actions to Restore and Repair Riparian Zones*
8) *Conduct Water Quality Research, Monitoring and Sampling*
9) *Enhance Stormwater and GI Programs*

For each of the measures, this plan identifies the responsible parties, technical and financial needs, monitoring and outreach efforts, and a schedule of activities. Implementation of the management measures will largely be dependent on the availability of funding.

The stakeholders and TCEQ will review progress under TCEQ's adaptive management process. The plan may be adjusted periodically as a result of progress reviews.

# Management Measure 1: Identify OSSFs, Prioritize Problem Areas, and Systematically Work to Bring Systems into Compliance

The purpose of this management measure is to identify OSSFs, prioritize problem areas, and systematically work to bring systems into compliance.

Failing OSSFs have been known to contribute to bacteria impairments in surface water bodies throughout Texas and in watersheds impaired by bacteria pollution. The

purpose of this management measure is to improve identification, inspection, pre-installation planning, education, operation, maintenance, and tracking of all OSSFs in the watershed to minimize potential water quality impacts from malfunctioning on-site systems. Potential OSSF failures will be addressed by working with homeowners and residents to identify and inspect all OSSFs within priority areas as depicted in Figure 5. Deficient systems should be repaired or replaced as appropriate to bring them into compliance with local requirements.

Identifying OSSFs in the impaired watersheds will be the first step in this process. Knowing the location of all on-site systems will aid in implementation efforts and help achieve the goal of reducing bacteria loading. In this initial step, responsible parties (i.e., local stakeholders, AgriLife Extension, local health department inspectors, or others) will collect geographic information system (GIS) data of known OSSFs in the watershed, as well as known wastewater infrastructure data. This effort can be initiated using 911 address point files, Certificates of Convenience and Necessity (CCN) layers, and 2020 Census block data. Following this exercise, dwellings and other facilities not served by existing wastewater service providers can be identified and further investigated. The TCEQ NPS Program is also helping fund the creation of a geodatabase for OSSFs that could be used as a starting point for this management measure. As OSSFs are identified, they will be tracked using GIS to document pertinent information related to the installation, operation, maintenance, and performance history of the systems. This tracking system will establish the basis for identifying potential problem areas and aiding in prioritizing these areas for action.

Once identified and prioritized, OSSFs will be inspected as time and funding allow. Physical inspections are necessary to properly identify problematic OSSFs or clusters of failing OSSFs. The Authorized Agent in the Oso watershed available for inspections for Nueces County is the City of Corpus Christi-Nueces County Health District. Additional funding is necessary to enable additional personnel to conduct these inspections. The inspections will provide critical input to the process of identifying priority areas of the watershed where repairs and replacements will be conducted first.

OSSF owners should be contacted to request permission to conduct inspections and to provide the owners information regarding proper maintenance, repairs, and replacements. These contacts will begin in identified priority areas and will continue through the rest of the Oso watershed. Upon receiving permission to conduct an inspection, responsible parties, as funding allows, will conduct on-site inspections, and consult with the owner on methods for maintenance, repairs, and replacements. This process should continue throughout implementation of this water quality improvement plan.

## Education Component

The level of general knowledge and understanding of O&M requirements for OSSFs is thought to be low throughout the Oso watershed. Education and outreach efforts for OSSFs will be targeted at homeowners and residents. Additionally, local officials will be targeted for outreach due to their ability to establish mechanisms that may mitigate pollution from OSSFs at community, county, watershed, and regional scales. Efforts

must also be made to deliver educational materials on proper OSSF O&M to homeowners. AgriLife Extension currently hosts education programs for homeowners about proper O&M requirements, and provides an overview of general OSSF requirements, collection and storage, pretreatment components, disinfection, final treatment and dispersal, selection, and permitting. Information about this program can be found at the AgriLife Extension OSSF website.[18] As funding allows, this program will be delivered in the Oso watershed to assist in meeting the educational goals of this plan.

Education and outreach activities to minimize or eliminate OSSF contributions to bacteria loading include:

1. Conducting a soil and water testing campaign. Nueces County Extension Agents for Texas A&M AgriLife Extension Service offer soil and water testing to encourage proper nutrient management in both agricultural and urban areas. Periodically, the City of Corpus Christi, in cooperation with the Extension Service, offers free and/or reduced-rate testing opportunities.

2. Providing stakeholder workshops. Texas A&M AgriLife Extension Service offers workshops and courses which cover the components of conventional septic systems and drain fields. Presentations provide a basic understanding of the O&M activities for a conventional septic system. Courses also explain how activities within the home can impact the operation of a septic system, and what the limitations of the site itself are to accept and provide treatment to the wastewater. Other programs provide an environmental overview of potential impacts to streams and landscape.

    a. Texas Well Owners Network – TWON. Texas A&M AgriLife Extension Service in cooperation with the TSSWCB.[19]

    b. Septic System Care for Homeowners: Texas A&M AgriLife Extension homeowners guide

3. Homeowner and residential surveys. AgriLife Extension, Sea Grant, TAMUCC, and others as appropriate would conduct surveys to assess OSSF knowledge of homeowners/residents.

4. OSSF assistance. Partners would provide financial and technical assistance for maintenance. Funding would need to be secured to continue and improve efforts that assist residential OSSFs in maintenance, cleanouts, and follow-up.

[18] https://ossf.tamu.edu/
[19] http://twon.tamu.edu/

# Priority Areas

Priority areas for this management measure have been divided into an implementation timeline described below for the next five years.

- Year 1 - Oso watershed rural homes, including homes within Colonias, such as Tierra Grande, Tierra Verde 1, 2 and 3, San Pedro, Rose Acres, Blue Bonnet Subdivision, Nueces Farm Tracts, Primavera, Spring Gardens, and homes within 150 ft of Oso Creek and its tributaries.
- Year 2 - Subdivisions in Flour Bluff: Tara, Golden Oaks and Rosher Estates.
- Year 3 - South Texas Nature Center and Botanical Gardens area subdivisions.
- Year 4 - London Independent School District homes and homes on FM 70.
- Year 5 - Continue to work with residents and homeowners in rural areas.

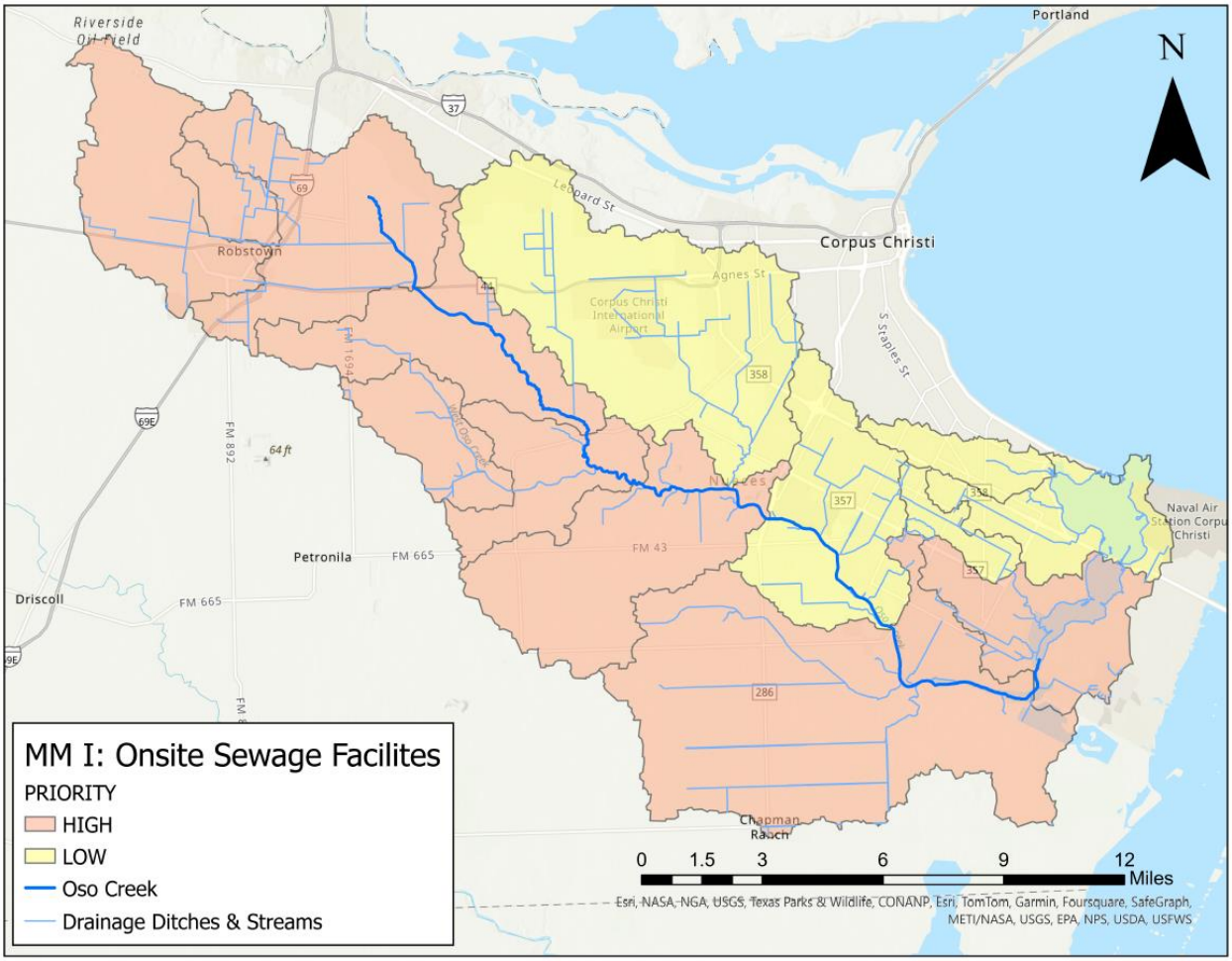


**Figure 5. Priority Areas for Oso Management Measure 1**

# Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between the City of Corpus Christi, the City of Robstown, Nueces County and CCNCHD, Oso work groups, local non-profit organizations (e.g., CBBEP), AgriLife Extension, OSSF homeowners, the watershed coordinator, and other

local stakeholders as applicable, will be beneficial to implementing this management measure.

## Technical Assistance

Technical assistance for this management measure may be provided by TCEQ Region 14, TCEQ's Small Business and Local Government Assistance Program, and TCEQ's Basics for Septic Systems webpage[20]. This assistance may include providing confidential environmental consultation with Nueces County without threat of enforcement actions. Compliance assistance and resources are available to local governments regarding OSSF permitting programs. AgriLife Extension may provide educational opportunities through the Texas Well Owner Network, Installer and Maintenance Provider Workshops, and OSSF O&M Workshops.

## Financial Assistance

Costs to all responsible parties are to be determined. Funding will be needed to repair or replace malfunctioning OSSFs within the watershed. For proper identification and documentation of failing OSSFs and follow-up after repairs or replacements, regional organizations are encouraged to hire a dedicated technician to oversee this process. Potential funding sources include:

- **Coastal Bend and Bays Estuaries Program**: The CBBEP is a non-regulatory, partnership-led effort working with industry, environmental groups, bay users, local governments and resource managers to protect and restore the health and productivity of bays and estuaries. CBBEP has partnered with the Nueces River Authority (NRA) to fund an OSSF repairs and replacement program in Nueces County that provides free septic system repair and replacement.
- **Coastal Management Program**: The CMP, administered by NOAA and TGLO, is a voluntary partnership between the federal government and U.S. Coastal and Great Lake states and territories. It is authorized by the Coastal Zone Management Act of 1972 to address national coastal issues. The Act provides funding for protecting, restoring, and responsibly developing our nation's diverse coastal communities and resources. To meet the goals of the Act, the National CMP takes a comprehensive approach to coastal resource management—balancing the often competing, and occasionally conflicting, demands of coastal resource use, economic development, and resource conservation. Some of the key elements of the National CMP include protecting natural resources, managing development in high hazard areas, giving development priority to coastal-dependent uses, providing public access for recreation, and coordinating state and federal actions. The CMP provides pass-through funding to TGLO, which, in turn, uses the funding to finance coastal restoration, conservation, and protection projects under TGLO's CMP.
- **CWA Section 319(h) Grants**: The EPA provides grant funding to Texas to implement the State's approved NPS Management Program. The EPA-approved Texas program provides the framework for determining which activities are eligible for funding under CWA Section 319(h). In general, these activities include

[20] www.tceq.texas.gov/assistance/water/fyiossfs.html

non-regulatory programs and are related to controlling NPS pollution. EPA-approved NPS programs cover costs associated with technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of specific NPS projects (EPA, 2022).

- **Supplemental Environmental Projects**: A SEP for OSSF repairs and replacements could be set up with TCEQ. The SEP program, administered by TCEQ, directs fines, fees, and penalties for environmental violations toward environmentally beneficial uses. Through this program, a respondent in an enforcement matter can choose to invest penalty dollars into improving the environment, rather than paying into the Texas General Revenue Fund. Program dollars may be directed to OSSF repair, trash dump clean up, and wildlife habitat restoration or improvement, among other things. Program dollars may be directed to entities for single, one-time projects that require special approval from TCEQ or directed to entities (such as Resource Conservation and Development Councils) with pre-approved "umbrella" projects.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- development of an OSSF database,
- the number of OSSF owners contacted for inspections and/or outreach,
- the number of OSSF inspections completed,
- the number of OSSFs repaired or replaced,
- the number of educational materials developed and distributed, and
- the number of attendees at workshops.

## Monitoring Component

The programmatic implementation progress for this management measure will be tracked through the number of OSSFs repaired or replaced and the number of educational activities completed. Other methods of monitoring the progress of OSSF improvements can be developed by the stakeholders preparing the plan (especially in priority areas). A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure.

## Implementation Schedule

**Year 1:**

- Develop a OSSF database to store OSSF information.
- Develop and submit a proposal to fund OSSF replacement and repair program.
- Identify and inspect OSSFs as described in the Priority Areas section, especially those in close proximity to waterways.
- Administer OSSF repair or replacement program to address deficient systems identified during inspections.
- Repair or replace six OSSFs, as funding allows.

- Conduct one OSSF O&M Workshop.
- Conduct one OSSF Installer and Maintenance Provider Workshop.

**Years 2 – 5:**

- Identify and inspect OSSFs as described in the Priority Areas section, especially those in close proximity to waterways.
- Maintain OSSF database.
- Administer OSSF repair or replacement program to address deficient systems identified during inspections.
- Repair or replace six OSSF systems per year, as funding allows.
- Provide stakeholder workshops such as the Texas Well Owner Network.
- Provide five-year Management Measure 1 progress report.

## Estimated Load Reductions

The plan calls for 30 systems to be repaired or replaced throughout the watershed over the first five years of I-Plan implementation. Identification and replacement of OSSFs will be based on their location within priority areas as outlined above, and their proximity to Oso Bay, Oso Creek, and their tributaries. If all 30 systems are replaced as outlined, a potential load reduction of 13,354,246.03 billion cfu/year is possible.

$$Load_{OSSF} = N_{OSSF} \times N_{hh} \times Production \times FCs \times Conversion \times 365\ days/year$$

Where:

$Load_{OSSF}$ = Potential annual load reduction of Enterococci attributed to OSSF repair/replacement, 13,354,246.03 billion cfu/year.

$N_{OSSF}$ = 30, Number of OSSFs repaired/replaced.

$N_{hh}$ = 2.63, Average number of people per household (U.S. Census Bureau, 2022).

***Production*** = 264,979 mL per person per day, Assumed sewage discharge rate (Horsley & Witten, 1996)

***FCs*** = 0.01 billion cfu/mL, Fecal coliform concentration in sewage (EPA. 2001)

***Conversion*** = .175, Conversion rate fecal coliform to Enterococci (Borel et al., 2012)

**Table 39. Summary of Management Measure 1: Identify OSSF, Prioritize Problem Areas and Systematically Work to Bring System into Compliance**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | Improperly functioning OSSFs |
| **Potential Load Reduction** | 13,354,246.03 billion cfu/year. |
| **Technical and Financial Assistance** | Technical assistance may include TCEQ Region 14 and the TCEQ Small Business and Local Government Assistance Program. Financial assistance may come from the Coastal Impact Assistance Program, CMP, and National Coastal Management Program, CWA 319(h) Grants, and a potential SEP. |
| **Educational Component** | Education and outreach program to broadly promote proper OSSF operation, such as OSSF and O&M Workshops, OSSF Installer and Maintenance Provider Workshops, and the Texas Well Owner Network. |
| **Schedule of Implementation** | • **Year 1:** Develop OSSF database. Develop proposal to fund OSSF replacement and repair program. Identify and inspect OSSFs as described in the Priority Areas section. OSSF repair and/or replacement program of deficient systems identified during inspections. Repair or replace up to six OSSF systems (contingent upon funding). Hold at least one OSSF O&M Workshop and one OSSF Installer and Maintenance Provider Workshop<br>• **Years 2-5:** Identify and inspect OSSFs as described in the Priority Areas section. Maintain OSSF database. Administer OSSF repair or replacement program to address deficient systems identified during inspections. Repair or replace up to six OSSF systems per year (contingent upon funding). Provide stakeholder workshops such as the Texas Well Owner Network. Provide five-year Management Measure 1 progress report. |
| **Interim, Measurable Milestones** | • Development of OSSF database.<br>• Number of OSSF owners contacted for inspections or outreach.<br>• Number of OSSF inspections completed.<br>• Number of OSSFs repaired or replaced.<br>• Number of educational materials developed and distributed.<br>• Number of attendees at workshops. |
| **Monitoring Component** | • **Programmatic:** Tracking of the number of OSSFs repaired or replaced and the number of educational activities completed. Five-year report.<br>• **Environmental:** Routine water quality monitoring conducted by TCEQ Clean River Program (CRP), and samples analyzed for implementation efforts by the watershed coordinator. |
| **Responsible Parties** | City of Corpus Christi, City of Robstown, Nueces County, AgriLife Extension, CBBEP, OSSF homeowners, residents, and stakeholders, City of Corpus Christi Health District, and the watershed coordinator |

# Management Measure 2. Promote, Develop and Implement Conservation Plans, Water Quality Management Plans and Wildlife Habitat Plans

The purpose of this management measure is to provide stakeholders with a variety of existing nonprofit and governmental (local, regional, state, and federal) programs who work with landowners to accomplish the overall goal of protecting priority areas within the watershed, as depicted in Figure 6. Water quality management plans (WQMPs), Conservation Plans, and Wildlife Habitat Plans are developed and implemented to protect, conserve, and enhance natural resources within the landowner's social and economic interests and abilities. Natural resources are defined by NRCS to include soil, water, air, plants, animals, energy, and human considerations. These programs are described below.

Promoting and implementing WQMPs and Conservation Plans is anticipated to provide direct benefits to water quality and can provide benefits to producers. A WQMP is a site-specific plan developed through and approved by Soil and Water Conservation Districts (SWCDs) for agricultural or silvicultural lands. The plan includes appropriate land treatment practices, production practices, management measures, technologies, or combinations thereof. The purpose of WQMPs is to achieve a level of pollution prevention or abatement determined by the TSSWCB, in consultation with local SWCDs, to be consistent with state water quality standards.

A Conservation Plan describes the schedule of implementation for practices and activities needed to solve identified natural resource concerns. The plan may include component plans that address one or more resource concerns, such as Comprehensive Nutrient Management Plans, Grazing Plans, Integrated Pest Management Plans, and Wildlife Management Plans. NRCS provides conservation planning and technical assistance to help plan and carry out conservation decisions, which includes onsite planning assistance in developing Conservation Plans. Landowners can also manage their lands to protect wildlife with the assistance of TPWD.

Establishing acreage under management practices in the priority subwatersheds is the primary goal of this management measure. To accomplish this goal, participating stakeholders should collaborate with state and federal agencies to garner the necessary technical and financial assistance, as resources are available, to implement these management practices under the appropriate programs requested by the landowner. Direct contact with landowners in priority areas will be made to discuss what a conservation plan is, its benefits, and other information necessary to inform landowners of the need for adoption of BMPs. Assistance at the local level may be needed to establish the necessary contacts.

Much of the Oso watershed outside of the City of Corpus Christi is used for growing crops, such as grain sorghum, and cotton. A few acres are used for grazing livestock. As with many areas used for crop production and grazing land, wildlife, native and exotic, are present on the land. This management measure will focus on these land uses and will focus on reducing bacteria loads in the rural portion of the watershed.

Wildlife has a significant impact on the Oso watershed in numerous ways, and as a result, periodic wildlife management workshops are warranted to provide information on management strategies and available resources to those interested. The watershed coordinator will work with AgriLife Extension Wildlife Specialists and TPWD as appropriate to plan and secure funding to deliver workshops in and near the Oso watershed. With the variety of wildlife species prevalent in the Oso watershed, it is anticipated that workshops focused on at least one game species will be delivered every other year. Wildlife management workshops will be advertised through newsletters, news releases, the project website, and other avenues as appropriate.

## Education Component

Education is one of the most important components of this management measure. An intensive education and outreach program is needed to broadly promote the adoption

of management practices through the appropriate programs. Awareness of the programs, management practices, and their benefits is often one of the largest factors affecting BMP adoption. Awareness should also be periodically assessed so that adjustments can be made to encourage adoption. Educational programs specific to some landowner interests currently exist and will also be used as a part of the education and outreach campaign.

Existing programs, such as the Lone Star Healthy Streams Program and the Statewide Riparian and Stream Ecosystem Management Education Program, are resources that will promote the adoption of BMPs. Lone Star Healthy Streams Program is a partnership between Texas A&M AgriLife Extension and TSSWCB to protect Texas waterways from bacterial contamination originating from livestock operations and feral hogs. The program's objective is to educate Texas farmers, ranchers, and landowners about proper grazing, feral hog management, and riparian area protection to reduce the levels of bacterial contamination in streams and rivers. Additionally, management practice field days will be held for the public to gain knowledge about how to implement specific BMPs throughout the watershed.

## Priority Areas

Priority areas for this management measure have been divided into an implementation timeline described below for the next five years. Throughout Years 1-5, priority should be given to rural and suburban agricultural lands in the watershed under row crop tillage, especially those adjacent to Oso Creek and its tributaries. This would also include vestigial agricultural lands within urban and suburban areas of the Oso watershed.

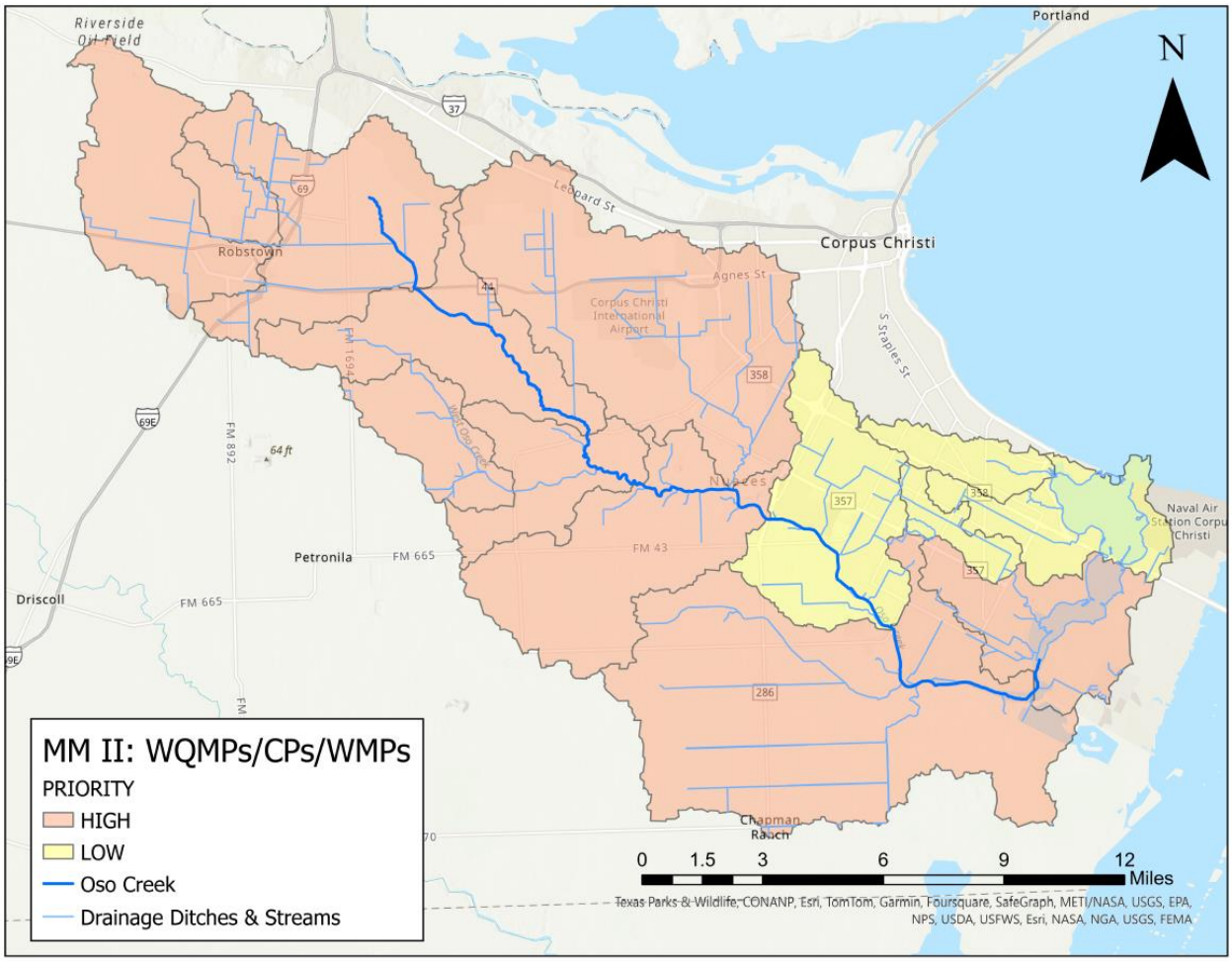


**Figure 6. Priority Areas for Oso Management Measure 2**

# Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between the USDA NRCS, Nueces Soil & Water Conservation District (NSWCD), Oso work groups, AgriLife Extension, the watershed coordinator, and other local stakeholders, as applicable will be beneficial to implementing this management measure activity. Additional responsible parties could be CBBEP, TPWD, TSSWCB, NRA, the Texas Agricultural Land Trust, and Texas Wildlife Association.

## Technical Assistance

The entities mentioned in this section can provide technical and financial assistance for this management measure, but funding sources should not be limited to these entities. The intent of the previously mentioned programs is for the agencies listed above to work with landowners to voluntarily implement Management and Conservation Plans. Technical assistance to agricultural producers for developing Management and Conservation Plans is provided through the TSSWCB's WQMP Program, which is funded through the State of Texas general revenue. Conservation

Plan resources can be obtained through TAMU AgriLife Extension Service and USDA/NRCS.

## Financial Assistance

Federal programs, such as USDA's most recent Farm Bill[21], will be targeted for financial resources. TSSWCB, SWCDs, and USDA NRCS will continue to provide appropriate levels of cost-share assistance to agricultural producers that will facilitate the implementation of BMPs and conservation programs in the Oso watershed, as described above. According to TSSWCB data, conservation plan development and implementation in this watershed has been moderately low; as such, it is anticipated that additional levels of funding will be needed to meet implementation needs.

- **Agricultural Conservation Easement Program**: USDA NRCS Agricultural Conservation Easement Program helps landowners, land trusts, and other entities protect, restore, and enhance wetlands or protect working farms and ranches through conservation easements
- **Conservation Innovation Grant**: USDA NRCS's Conservation Innovation Grant (CIG) is a voluntary program intended to stimulate the development and adoption of innovative conservation approaches and technologies while leveraging federal investment in environmental enhancement and protection, in conjunction with agricultural production. Under CIG, EQIP funds are used to award competitive grants to non-federal governmental or nongovernmental organizations, tribes, or individuals.
- **Conservation Stewardship Program - USDA NRCS**: The Conservation Stewardship Program **(**CSP) helps agricultural producers maintain and improve their existing conservation systems and adopt additional conservation activities to address priority resources concerns. Participants earn CSP payments for conservation performance—the higher the performance, the higher the payment.
- **Coastal Management Program**: The CMP, administered by NOAA and TGLO, is a voluntary partnership between the federal government and U.S. Coastal and Great Lake states and territories. It is authorized by the Coastal Zone Management Act of 1972 to address national coastal issues. The Act provides funding for protecting, restoring, and responsibly developing our nation's diverse coastal communities and resources. To meet the goals of the Act, the CMP takes a comprehensive approach to coastal resource management—balancing the often competing, and occasionally conflicting, demands of coastal resource use, economic development, and resource conservation. Some of the key elements of the CMP include protecting natural resources, managing development in high hazard areas, giving development priority to coastal-dependent uses, providing public access for recreation, and coordinating state and federal actions. The CMP provides pass-through funding to TGLO, which, in turn, uses the funding to finance coastal restoration, conservation, and protection projects under TGLO's CMP.

[21] https://www.congress.gov/bill/115th-congress/house-bill/2

- **Environmental Education Grants - EPA**: Under the EEG Program, the EPA seeks grant proposals from eligible applicants to support environmental education projects that promote environmental stewardship and help develop knowledgeable and responsible students, teachers, and citizens. This grant program provides financial support for projects that design, demonstrate, and/or disseminate environmental education practices, methods, or techniques as described in requests for proposals. Under this program, EPA has distributed between $2 and $3.5 million in grant funding per year since 1992.
- **EQIP - USDA/NRCS**: The EQIP is a voluntary program that provides financial and technical assistance to agricultural producers through contracts up to a maximum term of ten years. These contracts provide financial assistance to help plan and implement conservation practices that address natural resource concerns and for opportunities to improve soil, water, plant, animal, air, and related resources on agricultural land and non-industrial private forestland. An additional purpose of EQIP is to help producers meet federal, state, tribal, and local environmental regulations.
- **Farm Business Management and Benchmarking Competitive Grants Programs - USDA National Institute of Food and Agriculture**: The Farm Business Management and Benchmarking Competitive Grants Program provides funds to improve the farm management knowledge and skills of agricultural producers; and establish and maintain a national, publicly available, farm financial management database to support improved farm management.
- **Texas Water Development Board (TWDB)**: The TWDB offers a variety of cost-effective loan and grant programs that provide for the planning, acquisition, design, and construction of water related infrastructure and other water quality improvements.
- **National Coastal Wetlands Conservation Grants - U.S. Fish and Wildlife Service**: The National Coastal Wetlands Conservation Grants Program annually provides grants of up to $1 million to coastal and Great Lakes states, as well as U.S. territories to protect, restore and enhance coastal wetland ecosystems and associated uplands.
- **Regional Conservation Partnership Program - USDA NRCS**: The Regional Conservation Partnership Program (RCPP) is a new, comprehensive, and flexible program that uses partnerships to stretch and multiply conservation investments and reach conservation goals on a regional or watershed scale. Through RCPP, the NRCS and state, local, and regional partners coordinate resources to help producers install and maintain conservation activities in selected project areas. Partners leverage RCPP funding in project areas and report on the benefits achieved.
- **Southern Sustainable Agriculture Research and Education - Grants and Education to Advance Innovations in Sustainable Agriculture**: The Southern Sustainable Agriculture Research and Education (SARE) Program funds efforts that enhance the capabilities of Texas agricultural professionals in sustainable agriculture. Grants and education are available to advance innovations in

sustainable agriculture. The grants are aimed at advancing sustainable innovations and have contributed to an impressive portfolio of sustainable agriculture efforts across the nation.

- **Supplemental Environmental Project**: An SEP for land conservation activities could be set up with TCEQ. The SEP program, administered by TCEQ, directs fines, fees, and penalties for environmental violations toward environmentally beneficial uses. Through this program, a respondent in an enforcement matter can choose to invest penalty dollars into improving the environment, rather than paying into the Texas General Revenue Fund. Program dollars may be directed to OSSF repair, trash dump clean up, and wildlife habitat restoration or improvement, among other things. Program dollars may be directed to entities for single, one-time projects that require special approval from TCEQ or directed to entities (such as Resource Conservation and Development Councils) with pre-approved "umbrella" projects.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- the number of Conservation Plans, WQMPs, and Wildlife Habitat Plans developed, and
- the number of education and outreach programs delivered, number of attendees, and new materials developed.

## Monitoring Component

Programmatic monitoring of this management measure will consist of tracking the number of Conservation Plans developed. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure.

## Implementation Schedule

**Year 1:**

- Develop and implement at least one Conservation Plan, WQMP, and/or Wildlife Habitat Plan.
- Provide at least one workshop (i.e., Lone Star Healthy Streams Workshop).
- Attend Management Practice Field Days, as they become available.

**Years 2 – 5:**

- Develop and implement at least one additional Conservation Plan, WQMP, and/or Wildlife Habitat Plan annually.
- Provide at least one Riparian and Stream Ecosystem Management Education Program, the Oso watershed.
- Provide at least one workshop (i.e., Lone Star Healthy Streams Workshop).
- Attend Management Practice Field Days, as they become available.
- Provide five-year Management Measure 2 progress report.

# Estimated Load Reductions

Prescribed management will most effectively reduce direct deposition but will also reduce bacteria loads from the landscape as well. By implementing prescribed grazing, cross fencing, watering facilities, and other BMPs identified by local SWCDs, potential annual Enterococci loading reductions are calculated to be 3,801.07 billion cfu/year.

$$Load_{cattle} = N_{plans} \times Head/Operation \times Animal\ Unit\ Conversion \times FC_{cattle} \times Conversion \times Median\ Efficacy \times Prox \times 365\ days/year$$

Where:

***Load*$_{cattle}$** = Potential annual load reduction of Enterococcus tributed to cattle, 3,801.07 billion cfu/year.

***N*$_{plans}$** = 5, Number of Conservation Plans or WQMPs developed and implemented.

***Head/Operation*** = 16, Average number of head of cattle per operation in Nueces County (USDA, 2017).

***Animal Unit Conversion*** =1, Cattle to animal unit conversion factor (Wagner and Moench, 2009).

***FC*$_{cattle}$** = 8.55 billion cfu/day, Fecal coliform produced per animal unit per day (Wagner and Moench, 2009).

***Conversion*** = .175, Conversion from fecal coliform to Enterococci (Borel et al. 2012).

***Median Efficacy*** = .58, Median efficacy of selected conservation practices at reducing bacteria loads (TCEQ, 2023).

***Prox*** = .15, Proximity factor to account for distance of management practices from riparian areas (Escamilla et al. 2019).

**Table 40. Summary of Management Measure 2: Promote, Develop and Implement Conversation Plans, WQMPs and Wildlife Habitat Plans**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | Agricultural runoff |
| **Potential Load Reduction** | 3,801.07 billion cfu/year |
| **Technical and Financial Assistance** | Technical assistance will include TSSWCB, AgriLife Extension and County Extension Agents, NRCS, and SWCDs. Financial assistance will consist of aid from Coastal Zone Management Administration Awards, CIGs, Conservation Stewardship Program, EEGs, EQIP Program, FMBM Program, Federal CWA **Section** 319(h) Grants (EPA/TSSWCB), RCPP, SARE, Targeted Watershed Grants Program, and TSSWCB WQMP Program. |
| **Educational Component** | An intensive education and outreach program is needed to broadly promote the adoption of BMPs through appropriate education programs, such as Lone Star Healthy Streams, Riparian and Stream Ecosystem Management, and Management Practice Field Days. |

| | |
|---|---|
| **Schedule of Implementation** | • **Year 1:** Develop and implement at least one Conservation Plan, WQMP, and/or Wildlife Conservation Plan Provide at least one workshop (i.e., Lone Star Healthy Streams Workshop). Attend Management Practice Field Days, as they become available.<br>• **Years 2-5:** Develop and implement at least one additional Conservation Plan, WQMP, and/or Wildlife Habitat Plan annually. Provide at least one Riparian and Stream Ecosystem Management Education Program, the Oso watershed. Provide at least one workshop (i.e., Lone Star Healthy Streams Workshop). Attend Management Practice Field Days, as they become available. Provide five-year Management Measure 2 progress report. |
| **Interim, Measurable Milestones** | • Number of Conservation Plans developed and implemented.<br>• Number of education programs delivered, number of attendees, and new materials developed. |
| **Monitoring Component** | • **Programmatic:** Track the number of Conservation Plans developed. Five-year report.<br>• **Environmental:** TCEQ CRP watershed coordinator monitoring. |
| **Responsible Parties** | Watershed coordinator, local stakeholders, TAMU AgriLife Extension, CBBEP, NRCS, TPWD, TSSWCB, and NSWCD |

# Management Measure 3. Promote the Management of Feral Hog Populations

Feral hogs have been identified as significant contributors of pollutants to surface water bodies within Texas. Fecal matter deposited directly into streams by feral hogs contributes bacteria and nutrients, polluting the state's water bodies.

In addition, extensive rooting activities of groups of feral hogs can cause extreme erosion and soil loss. The destructive habits of feral hogs cause an estimated $52 million worth of agricultural crop and property damage each year in Texas. Also, it has been estimated that 60% to 70% of feral hogs would need to be removed annually to hold the population stable with no increase (Burns, 2011). Stakeholders in watersheds across the state have recommended that efforts to control feral hogs be undertaken to reduce the population, limit the spread of these animals, and minimize their effects on water quality and the surrounding environment.

The purpose of this management measure is to manage the feral hog population within priority areas, as depicted in Figure 7, such that the current population does not increase. With significant removal of feral hogs from the watershed on an annual basis, and sustained efforts to keep the population at a manageable level, water quality improvements may be realized. Various control efforts may be employed, such as live trapping, shooting, hunting with dogs, aerial hunting, exclusion, and habitat management.

Continuing these practices—especially in priority areas—along with technical and financial assistance, will help achieve the overall goal of improving water quality. Activities will be targeted towards priority areas where landowners should be contacted to discuss the economic savings of removing feral hogs, specific methods for doing so, and available programs that assist in feral hog removal.

## Education Component

Education and outreach for this management measure is needed to ensure that stakeholders understand the importance and economic benefits of feral hog removal. Some educational programs exist through AgriLife Extension, but services offered by AgriLife Extension are statewide programs and funding for personnel is limited. Stakeholders would benefit greatly by receiving educational materials. Therefore, a targeted education campaign should be implemented consisting of multiple educational opportunities for stakeholders, including the development, and dissemination of educational materials.

Promotion of feral hog management can be achieved through AgriLife Extension's Feral Hog Management Program, which provides information to landowners and the public on feral hog control, damage, diseases, and hunting. Other educational activities could include promoting feral hog surveys, feral hog harvest and bounty programs, a tracking tool for hog harvest data, and feral hog management strategy trainings. Programs that could be used for the educational component of this management measure include Lone Star Healthy Steams Program Workshops, Wildlife for Lunch-Feral Hogs Webinars, Wild Pig Damage Abatement Education, and Applied Research Activities.

## Priority Areas

Priority areas for this management measure have been divided into an implementation timeline described below for the next five years. Years 1-5 priority areas are the properties along Oso and La Volla Creeks and their tributaries, and the Oso Bay shoreline, including Flour Bluff and King Ranch.

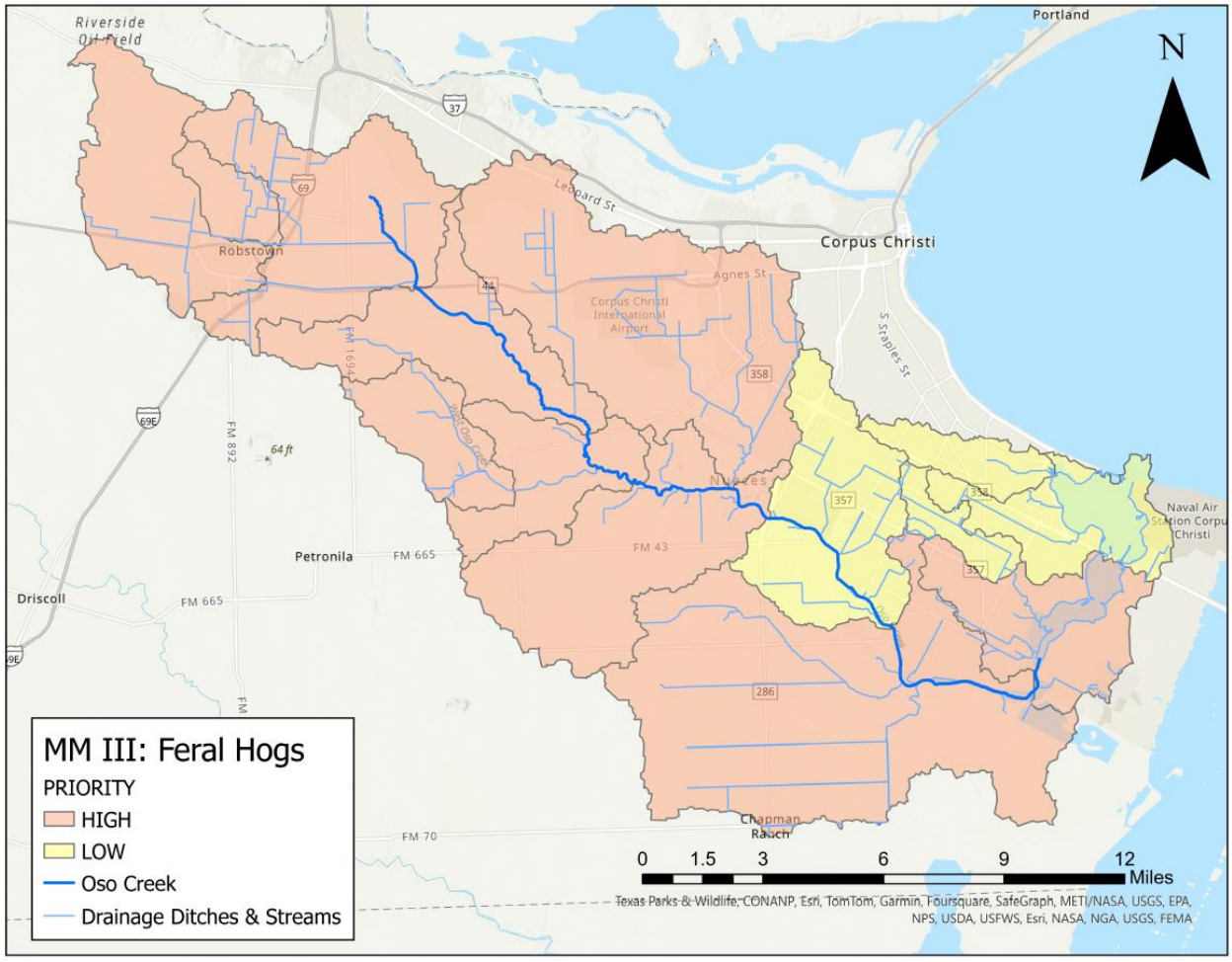


**Figure 7. Priority Areas for Oso Management Measure 3**

# Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between the City of Corpus Christi, the City of Robstown, Nueces County, Oso work groups, local non-profit organizations (e.g., CBBEP), TPWD, landowners/land managers/lessees, the watershed coordinator, and other local stakeholders as applicable, will be beneficial to implementing this management measure activity. Other potential responsible parties include the USDA NRCS, TSSWCB, and NSWCD.

## Technical Assistance

AgriLife Extension's Feral Hog Management Program and Texas Wildlife Services (TWS), TPWD's Private Lands and Habitat Program, USDA's Feral Swine Resources and Outreach Materials, TAMU's Feral Hog Abatement and Landowner Education Program, TSSWCB's Feral Hog Management in Priority Watershed Program, and the Extension Foundation's Feral Hog Program will provide, as needed, technical assistance for Management Measure 3.

### Financial Assistance

Federal, state, and local agencies provide support to entities and individuals as they seek to manage feral hog populations in the Oso watershed. Potential funding sources include:

- **CWA Section 319(h) Grants**: EPA provides grant funding to Texas to implement the state's approved NPS Management Program and is administered by TCEQ and TSSWCB. The EPA-approved Texas program provides the framework for determining which activities are eligible for funding under CWA Section 319(h). In general, these activities include non-regulatory programs and are related to controlling NPS pollution. EPA-approved NPS programs cover costs associated with technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of specific NPS projects. (EPA, 2022)
- **Texas Department of Agriculture**: Since 2008, the Texas Department of Agriculture (TDA) has awarded grants to TWS for a feral hog abatement program. The grants are used to carry out a number of specifically identified direct control projects where control efforts can be measured. Certain areas of the state have been targeted due to the contributions from feral hogs to impaired water quality and bacteria loading.
- **County Hog Abatement Matching Program (CHAMP)**: TDA administers CHAMP, which is designed to encourage counties across Texas to create partnerships with other counties, local governments, businesses, landowners, and associations to reduce feral hog populations and the damage caused by these animals in Texas. To be eligible to receive an award from CHAMP, a Texas county must partner with at least one other Texas county and may partner with other local entities.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- the number of educational programs delivered per year,
- the number of educational materials developed and disseminated,
- the number of individuals reached,
- the number of feral hogs removed per year, and
- the number of exclusions installed.

## Monitoring Component

The programmatic monitoring of progress of this management measure are the number of feral hogs removed and/or estimated population counts of feral hogs in the Oso watershed per year. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure.

# Implementation Timeline

**Years 1-5:**

- Promote voluntary construction of fencing around deer feeders to keep feral hogs out.
- Identify travel corridors and employ trapping and hunting in these areas to reduce feral hog numbers.
- Voluntarily remove feral hogs especially in priority areas and ensure lessees dispatch hogs on site.
- Promote use of AgriLife Extension's online tracking tool to report hog harvest data.
- Develop and implement a Feral Hog Management education program.
- Develop and implement a Wildlife Management education program.
- Provide five-year Management Measure 3 progress report.

# Estimated Load Reductions

Reducing the feral hog population will reduce bacteria loading to the landscape and direct deposition to the Oso watershed. This effort will primarily reduce direct deposition as these animals spend the majority of their time in the riparian corridors. Expected Enterococci load reduction from reduced feral hog populations is 2,386.29 billion cfu/year.

$$\textbf{Load}_{FH} = N_{FH} \times \textit{Animal Unit Conversion} \times FC_{FH} \times \textit{Conversion} \times 365\ \textit{days/year}$$

Where:

**Load**$_{FH}$ = Potential annual load reduction of Enterococci attributed to removal of one feral hog, 2,386.29 billion cfu/year.

**N**$_{FH}$ = 247, Number of feral hogs removed, 60% of the total hogs in the Oso watershed (TCEQ, 2017).

**Animal Unit Conversion** = .125, Feral hog to animal unit conversion factor (Wagner & Moench, 2009).

**FC**$_{FH}$ = 1.21 billion cfu/day, Fecal coliform produced per animal unit (Wagner & Moench, 2009).

**Conversion** = .175 Conversion rates from fecal coliform to Enterococci (Borel et al. 2012).

**Table 41. Summary Management Measure 3: Promote the Management of Feral Hog Populations**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | Fecal deposition from feral hogs |
| **Potential Load Reduction** | 2,386.29 billion cfu/year |
| **Technical and Financial Assistance** | Technical assistance will include AgriLife Extension and TWS. Financial assistance will consist of aid from State CWA 319(h) Grants, TSSWCB, TDA, CHAMP, TWS. |

| | |
|---|---|
| **Educational Component** | An education and outreach program is needed to broadly promote the adoption of BMPs, such as Feral Hog Management and Wildlife Management education programs. |
| **Schedule of Implementation** | **Year 1-5:** Promote voluntary construction of fencing. Identify travel corridors for trapping and hunting. Remove hogs. Promote use of Extension's online tracking tool for reporting harvest data. Develop and implement a Feral Hog Management education program. Develop and implement a Wildlife Management education program. Provide five-year Management Measure 3 progress report. |
| **Interim, Measurable Milestones** | • Number of educational programs delivered per year.<br>• Number of educational materials developed and disseminated.<br>• Number of individuals reached.<br>• Number of feral hogs removed per year.<br>• Number of exclusions installed. |
| **Monitoring Component** | • **Programmatic:** Track the number of feral hogs removed and/or estimated population counts of feral hogs in the Oso watershed per year. Five-year report.<br>• **Environmental:** Routine ambient monitoring conducted by TCEQ, and the NRA partners can be used to assess the condition of the receiving water bodies. |
| **Responsible Parties** | City of Corpus Christi, City of Robstown, Nueces County, TAMU AgriLife Extension, CBBEP, NRCS, TPWD, Local Stakeholders, NSWCD, Watershed Coordinator |

# Management Measure 4. Promote the Reduction of Illicit Dumping and Proper Disposal of Animal Carcasses

The coastal area around the Oso watershed is a place where seasonal living is popular, and the area has seen an increase in portable homes, such as recreational vehicles (RVs). These portable homes contain bathrooms that need to be emptied periodically to dispose of the waste. Scattered throughout the watershed are disposal sites; however, there is often a fee for using these disposal facilities and as a result, the owners of the RVs sometimes illegally dispose of their waste in or near local water bodies.

Illicit dumping is a pollutant source and can also include things such as improperly disposed of trash, household items, waste, animal carcasses, and other debris. During rain events, these items can wash downstream and onto neighboring lands.

Watersheds with prime natural habitats, large tracts of well managed land, and an abundance of game animals are attractive for hunters, and a destination for outdoor sportsmen. A common practice for some that harvest game species is to dispose of the carcasses in low lying areas, away from well-traveled roads and recreational areas. Often, these disposal areas are near local water bodies. Education on proper disposal of animal carcasses by recreational hunters is needed to reduce their disposal near local water bodies.

Challenges in enforcing illicit dumping include a lack of available personnel for education and enforcement, obtaining the equipment necessary to reduce dumping, monitoring sites for enforcement, and other challenges. The purpose of this management measure is to reduce the amount of illicit dumping occurring throughout

the watershed. Through various efforts, including education (for both local officials and residents), signage at water bodies, enforcement, and other efforts, illicit dumping in the Oso watershed can be reduced.

## Education Component

Education for both residents and local officials is important for the success of this management measure. Local officials need to understand the implications of illicit dumping and the strategies to reduce this source of pollution. Potential educational opportunities for local officials are available through the TIDRC[22], which also provides continuing education units. Residents must also be educated, so that the public understands the harmful effects of illicit dumping on local water bodies. Some possible methods of education could include, but are not limited to, signage at bridge crossings, educational inserts in water bills, and other methods designed to reach the public.

Additionally, there is a need for an educational campaign that consists of informing recreational hunters and local landowners about the proper disposal of animal carcasses. Other targeted educational efforts should be conducted on the proper disposal of RV waste. For this campaign, educational materials can be developed and disseminated through a variety of avenues including, but not limited to, RV and mobile home communities, feed stores, direct mailing, newspaper articles, magazine articles, and billboards.

Planned education and outreach activities include signage that would provide the public with information on reporting illegal dumping. “No Dumping” signs to private landowners, and “Don’t Mess with Texas” signs should be made available. A targeted anti-littering campaign should also be developed. The Up2U is a very successful anti-littering campaign developed by NRA. The Clean Rivers and Beaches campaign for swimmers, kayakers, and tubers on the rivers of the Upper Nueces Basin has reached 120,000 people since its inception and could be adopted and implemented in the Oso watershed.

## Priority Areas

Currently, the entire Oso watershed is a high priority for this measure. More specific priority areas for Years 1 -5 of implementation of this management measure can be identified by consulting with Nueces County Constables, Nueces County Sheriff Department, City of Robstown Police and Solid Waste, City of Corpus Christi Police and Solid Waste, and area residents on hot spots of illegal dumping in the Oso watershed. County Roads adjacent to Oso Creek and its tributaries, nuisance properties, would be monitored and repeat offenders would be identified.

[22] https://www.tidrc.com/index.html

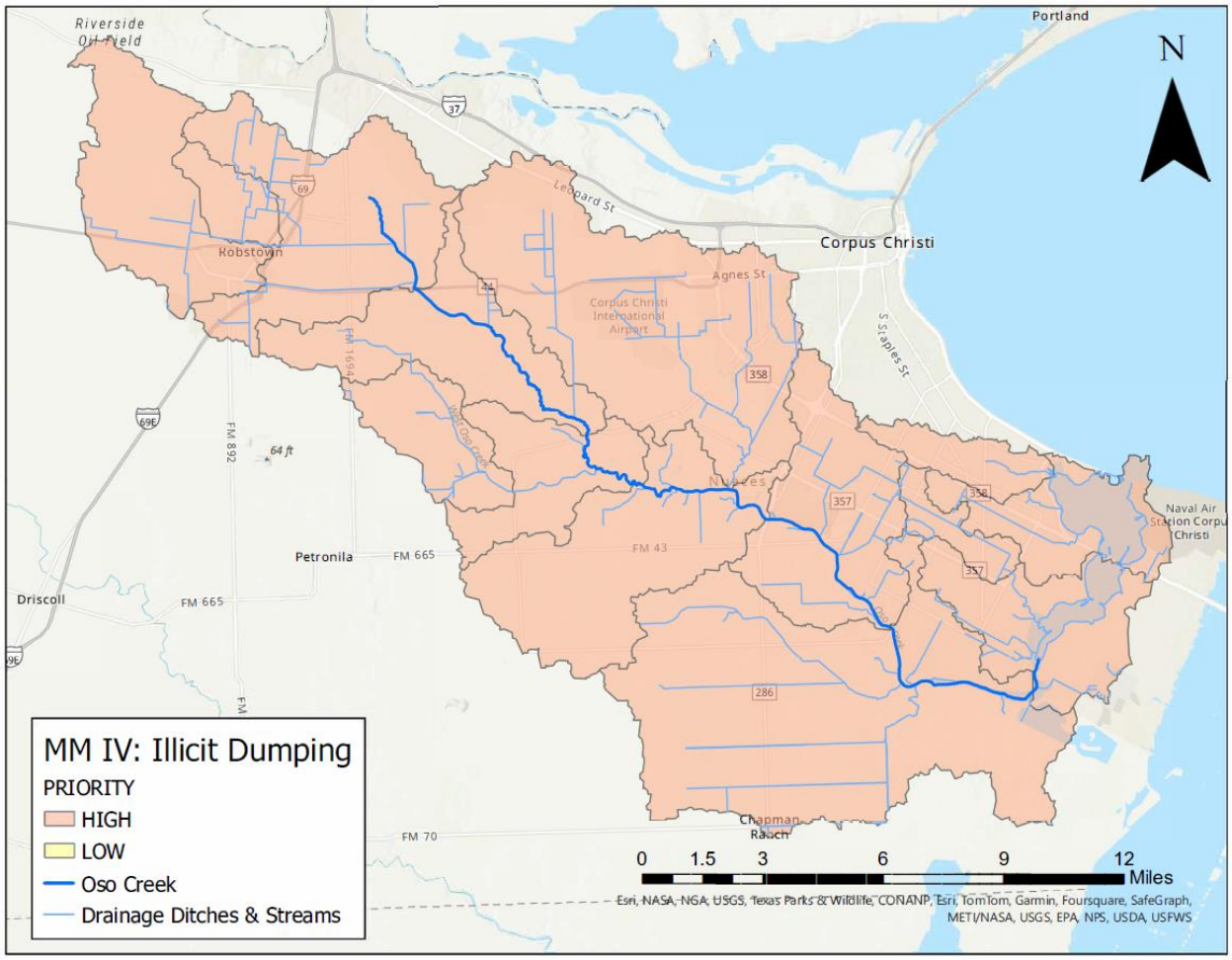


**Figure 8. Priority Areas for Oso Management Measure 4**

# Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between the law enforcement and departmental staff of City of Corpus Christi, the City of Robstown, Nueces County and County Commissioners, as applicable will be beneficial to implementing this management measure activity. Additional possible responsible parties include Oso work groups, the watershed coordinator, and other local stakeholders.

## Technical Assistance

Technical assistance for this management measure is available, as needed, from TCEQ Region 14 and the TCEQ Small Business and Local Government Assistance Program. Through this program, TCEQ can provide confidential assistance to local governments without the threat of enforcement actions. The program can connect local government entities with technical resources on municipal solid waste programs. Local AgriLife Extension agents can assist in educational activities related to mitigation of illicit dumping. County and city staff will be needed to secure and install signage. Technical assistance can also be provided by TCEQ's Take Care of Texas and Don't Mess with

Texas Water[23] programs, TxDOT's Don't Mess with Texas - Report a Litterer Program, and TIDRC's Enforcement Resources for Texas Cities and Counties publication.

### Financial Assistance

Federal, state, and local agencies provide support to entities and individuals as they seek to reduce the amount of illegally dumped waste in the Oso watershed. Contributions from local governments in terms of technical and financial assistance will be key to reducing waste from illegal dumping. Possible sources of funding for this management measure are listed below:

- **CWA Section 319(h) Grants**: EPA provides grant funding to Texas to implement the state's approved NPS Management Program and is administered by TCEQ and TSSWCB. The EPA-approved Texas program provides the framework for determining which activities are eligible for funding under CWA Section 319(h). In general, these activities include non-regulatory programs and are related to controlling NPS pollution. EPA-approved NPS programs cover costs associated with technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of specific NPS projects. (EPA, 2022)
- **USDA Rural Utilities Service Water and Waste Disposal (WWD) Loans and Grants**: USDA Rural Utilities Service provides funding for water and waste facility construction in rural communities (populations of 10,000 or less). The program also provides funding to organizations to provide technical assistance and training to communities in relation to water and waste activities. The intent of the program is to ensure that the neediest areas receive funding. Table 49 shows the estimated costs of developing and implementing educational activities and programs designed to reduce illicit dumping.
- **Regional Solid Waste Grants Program**: TCEQ provides grants to regional councils of governments to fund solid waste management activities and various local and regional projects that help implement solid waste management plans.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- installing five signs per year at creek crossings deterring illegal dumping,
- the number of illegal and illicit dumping education programs developed and delivered, and
- the number of educational programs delivered related to illegal dumping.

## Monitoring Component

The programmatic monitoring of this management measure will consist of tracking the number of signs installed and the number of programs developed and delivered. Additional monitoring may be implemented as needed and as funding allows. A five-

[23] www.tceq.texas.gov/p2/dont-mess-with-texas-water-a-way-to-report-illegal-dumping

year report will be submitted to TCEQ, summarizing all activities related to this management measure.

## Implementation Schedule

**Year 1:**

- Submit proposal to acquire personnel and equipment and develop or acquire existing educational materials.
- Install and maintain five signs at crossings throughout the Oso watershed.
- Work with appropriate entities to develop illegal dumping and animal carcass disposal education programs.
- Propose additional solid waste ordinances in coordination with Management Measure Activity 6.10.

**Years 2-5:**

- Continue to acquire equipment needed to reduce illicit dumping.
- Install and maintain five additional signs at crossings throughout the Oso watershed annually.
- Continue to develop illegal dumping and animal carcass disposal education programs.
- Continue, expand, and promote Household Hazardous Waste Collection Days.
- Adopt and enforce additional solid waste ordinances in coordination with Management Measure Activity 6.10.
- Provide five-year Management Measure 4 progress report.

## Estimated Load Reductions

A method to quantify potential pollutant load reductions from managing illicit dumping has not been developed at this time, therefore no estimated load reduction was calculated for this management measure.

**Table 42. Summary Management Measure 4: Promote the Reduction of Illicit Dumping and Proper Disposal of Animal Carcasses**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | Illegal dumping |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance** | Technical assistance will include TCEQ's Take Care of Texas and Don't mess with Texas water programs, TxDOT's Don't Mess with Texas – Report a Litterer, TIDRC, Texas A&M Engineering Extension Service , Texas Rural Water Association . Financial assistance will consist of the Clean Water State Revolving Fund Economically Distressed Areas Program, WWD Loans and Grants. |
| **Educational Component** | Continuing education units and signage at stream crossings that would provide the public with information on reporting illegal dumping. Continuation of the Up2U anti-littering campaign. An educational campaign |

| | |
|---|---|
| | to educate recreational hunters and local landowners about the proper disposal of animal carcasses. |
| **Schedule of Implementation** | • **Year 1:** Submit proposals to acquire personnel, equipment, and develop educational materials: Install and maintain five signs at crossings throughout the Oso watershed. Work with appropriate entities to eliminate illegal dumping and animal carcass disposal. Propose solid waste ordinances.<br>• **Years 2-5:** Continue to acquire equipment needed to reduce illicit dumping. Install and maintain five additional signs at crossings throughout the Oso watershed annually. Continue development of illegal dumping and animal carcass disposal education programs. Continue, expand and promote Household Hazardous Waste Collection Days. Adopt and enforce additional solid waste ordinances. Provide five-year Management Measure 4 progress report. |
| **Interim, Measurable Milestones** | • Install five signs per year at creek crossings deterring illegal dumping,<br>• Number of illegal and illicit dumping education programs developed and delivered.<br>• Number of educational programs given related to illegal dumping. |
| **Monitoring Component** | **Programmatic:** The amount of properly disposed of materials through the Up2U program. The number of educational activities conducted. Five-year report. |
| **Responsible Parties** | Watershed coordinator, law enforcement of City of Corpus Christi, City of Robstown, and Nueces County |

# Management Measure 5. Promote Wastewater Collection and Treatment Systems Improvements

This management measure focuses on reducing bacteria loadings from WWTFs and finding and replacing broken sewer lines. Currently, WWTFs are permitted to discharge wastewater containing bacteria concentrations that do not exceed surface water quality standards, which are 126 cfu/100 mL *Escherichia coli* (*E. coli*) for freshwater, and 35 cfu/100 mL Enterococci for saltwater. Keeping the concentration of bacteria in wastewater effluent below half of the permitted limit is a part of the bacteria management strategy in many water quality improvement plans in Texas.

WWTF operators can adopt measures that can keep bacteria concentrations in the effluent of their facilities at or below half of the surface water quality standards. For this activity, participating WWTFs within the priority areas (Figure 9) will endeavor to maintain bacteria concentrations in the effluent of their facilities below half of the surface water quality standards. In doing so, participating WWTFs will not exceed a bacteria concentration of 63 MPN/100 mL for *E. coli* and 17.5 MPN/100 mL for Enterococci in their treated wastewater effluent.

Stakeholders such as local academic institutions or research staff can coordinate with the cities of Corpus Christi and Robstown, and professional contractors if needed, to determine the feasibility of wastewater reuse for habitat enhancement, irrigation use, wetland development, or other opportunities.

It should be noted that the adoption of half the permitted discharge limit can be a voluntary measure undertaken by participating WWTFs or they can agree to have the limits written into their discharge permits.

## Education Component

The educational component of this management measure will consist of educating the public, developers, and WWTF employees on SSOs and what can be done to prevent them, educating the public and local businesses of the importance of properly disposing of FOG, and educating operators and/or staff on identifying aging and failing infrastructure through workshops and trainings.

## Priority Areas

Priority areas for this management measure have been divided into an implementation timeline described below for the next five years, as shown in Figure 9. The priority area for Year 1 of implementation will be areas in the Oso watershed that contain WWTFs or are serviced by such facilities, like the Greenwood WWTF. The goal in Year 1 will be to identify top priorities within the watershed and the City of Corpus Christi, City of Robstown, Nueces County, and other areas. The priority areas that will be focused on in Years 2 - 5 will be identified areas that contain municipal conveyances and treatment facilities that require improvement.

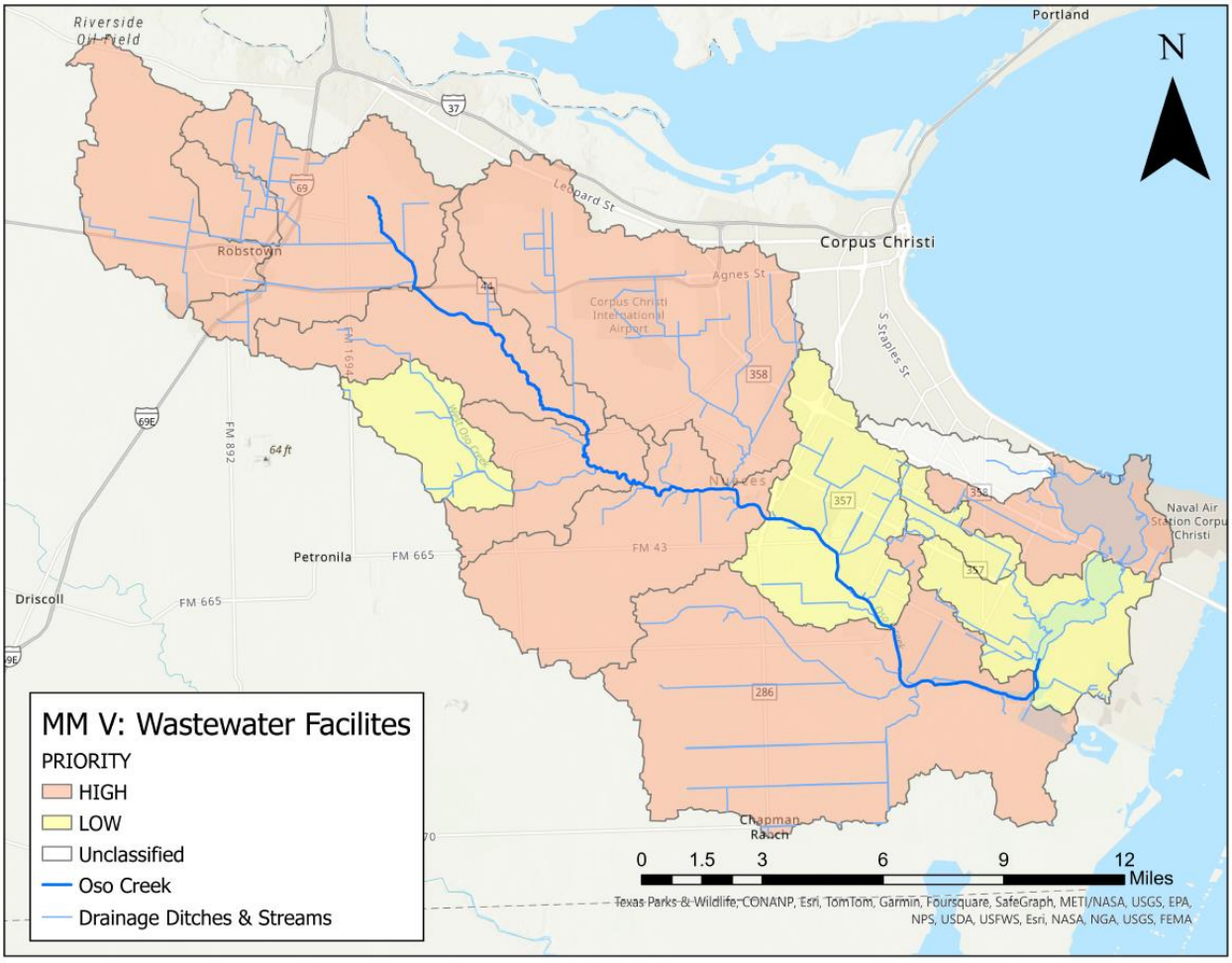


**Figure 9. Priority Areas for Oso Management Measure 5**

# Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between the City of Corpus Christi, the City of Robstown, Oso work groups, WWTFs permitted to discharge wastewater into the Oso creek, the watershed coordinator, and other local stakeholders as applicable, will be beneficial to implementing this management measure activity.

## Technical Assistance

Technical assistance sources include TCEQ's Small Business and Local Government Assistance Program that provides small businesses and local government technical assistance with environmental compliance in water, air, and waste, without threat of enforcement. TCEQ offers technical assistance through its Troubleshooting Bacteria Levels at Wastewater Treatment Plants guidance document[24].

## Financial Assistance

Financial assistance sources include:

- **Clean Water State Revolving Fund (CWSRF) Loan Program**: an EPA program conducted by TWDB that provides low-cost financial assistance for planning, acquisition, design and construction of wastewater, reuse and stormwater infrastructure.
- **Economically Distressed Areas Program (EDAP)**: A program conducted by TWDB that provides financial assistance for projects serving economically distressed residential areas where water or sewer services do not exist, or existing systems do not meet minimum state standards.
- **Water and Waste Disposal (WWD), and Environmental Loan and Grant Programs**: This is a program conducted by the USDA that provides funding for clean and reliable drinking water systems, sanitary sewage disposal, sanitary solid waste disposal and stormwater drainage to households and businesses in eligible rural areas.

# Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- the number of documented replacements and repairs of wastewater conveyance infrastructure and/or treatment facility repairs and improvements,
- the number of wastewater infrastructure failures reported to appropriate authorities,
- the number of commercial cross-connections found,
- the number of commercial leaking/broken sewer laterals found,
- the number of educational programs or materials delivered,
- the number of effluent outfall samples that are at or below 63 MPN/100 mL or 17.5 MPN/100 mL, and

[24] www.tceq.texas.gov/downloads/assistance/publications/rg-515.pdf

- the number of meetings held between stakeholders and city staff to discuss conducting a wastewater reuse feasibility study.

## Monitoring Component

Monitoring the progress of this management measure could be done by analyzing submitted outfall data to determine if the effluent discharged is at or below half the surface water quality standard per the WWTF's permit limit. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure.

## Implementation Schedule

**Years 1-5:**

- Coordinate one workshop or training each year for WWTF operators or staff on identifying aging and failing infrastructure.
- Identify the oldest parts of the collection system and areas with significant I/I, plan projects to repair or replace components, and coordinate repairs with WWTF upgrades when possible.
- Conduct private sewer line and cross-connection inspections, when feasible.
- Stakeholders and city staff can discuss conducting a wastewater reuse feasibility study.
- Provide five-year Management Measure 5 progress report.

## Estimated Load Reductions

An estimated load reduction was not calculated for this management measure due to this management measure activity only planning implementation for outreach and education events.

**Table 43. Summary Management Measure 5: Promote Wastewater Collection and Treatment Systems Improvements**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | WWTF effluent, broken or leaking private sewer laterals |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance** | Technical assistance could include TCEQ Small Business and Local Government Assistance Program. TCEQ also offers technical assistance through its Troubleshooting Bacteria Levels at Wastewater Treatment Plants guidance document. Financial assistance could consist of CWSRF administered by TWDB, EDAP administered by TWDB, WWD Loans and Grants USDA. |
| **Educational Component** | Educate the public, developers, and WWTF employees on SSOs and what can be done to prevent them. Educate the public and local businesses of the importance of properly disposing of FOG. Educate operators and/or staff on identifying aging and failing infrastructure through workshops and trainings. |
| **Schedule of Implementation** | **Years 1-5:** Coordinate one workshop or training each year for WWTF operators or staff on identifying aging and failing infrastructure. Identify the oldest parts of the collection system and areas with significant I/I, plan projects to repair or replace components, and coordinate repairs with WWTF upgrades when possible. Conduct private sewer line and |

| | |
|---|---|
| | cross-connection inspections, when feasible. Stakeholders and city staff can discuss conducting a wastewater reuse feasibility study. Provide five-year Management Measure 5 progress report. |
| **Interim, Measurable Milestones** | • Number of documented replacements and repairs of wastewater conveyance infrastructure.<br>• Number of wastewater infrastructure failures reported to appropriate authorities.<br>• Number of educational programs or materials delivered.<br>• Number of effluent outfall samples that are at or below 63 MPN/100 mL of E. coli or 17.5 MPN/100 mL of Enterococcus.<br>• Stakeholders and city staff can discuss conducting a wastewater reuse feasibility study. |
| **Monitoring Component** | **Programmatic:** Track WWTF permit compliance. Five-year study. |
| **Responsible Parties** | City of Corpus Christi, City of Robstown, other permitted wastewater dischargers, watershed coordinator and local academic institutions or research staff. |

# Management Measure 6. Promote Proper Management of Pet Waste

Pet waste can be a contributor of bacteria in water bodies through runoff from urban areas where there is a large amount of impervious cover during rain events. If pet waste is washed into the storm drain, it ends up in lakes, streams, and bays.

There are several approaches that can help manage bacteria contributions from pet waste. Promoting the proper disposal of pet waste is an important factor in managing it directly, especially in areas adjacent to water bodies. Installing pet waste stations in common areas can also play a key role in preventing bacteria from entering stormwater conveyance systems. Pet waste stations can both educate the public and make disposing of pet waste more convenient which is critical for changing human behavior.

Municipalities within the watershed can also adopt enforceable pet waste ordinances to enforce the proper disposal of pet waste. Without having enforceable ordinances in place, pet waste collection is voluntary. These ordinances are critical, especially in high use public areas or areas that produce increased runoff during rains. Enforcement by local governments is necessary after ordinances have been adopted. Stakeholders, residents, and local businesses can encourage homeowners' associations to include pet waste control provisions in new and existing by-laws.

Spay and neuter programs do not directly reduce the waste from the animals they address, but instead prevent future pet waste from entering waterbodies by reducing pet and feral animal populations.

This management measure focuses on reducing bacteria loadings from pet waste within the priority areas (Figure 10).

## Education Component

Providing education and outreach materials to pet owners about bacteria pollution and how pet waste can increase pollution in the impaired water bodies is critical for the success of this management measure. Materials will be distributed at events and appropriate locations, such as pet stores or veterinary clinics located in the Oso watershed. A campaign where citizens, veterinarians, and other pet advocates can make a "No Poop" pledge should also be developed.

## Priority Areas

Priority areas for this management measure have been divided into an implementation timeline described below for the next five years.

- Year 1 - Oso Bay shoreline along Ennis Joslin Road, including Hans and Pat Suter Park, student apartments, and adjacent neighborhoods
- Year 2 - London School areas
- Year 3 - Oso Parkway and adjacent neighborhoods
- Year 4 - Flour Bluff and adjacent neighborhoods
- Year 5 - Botanical Gardens subdivisions

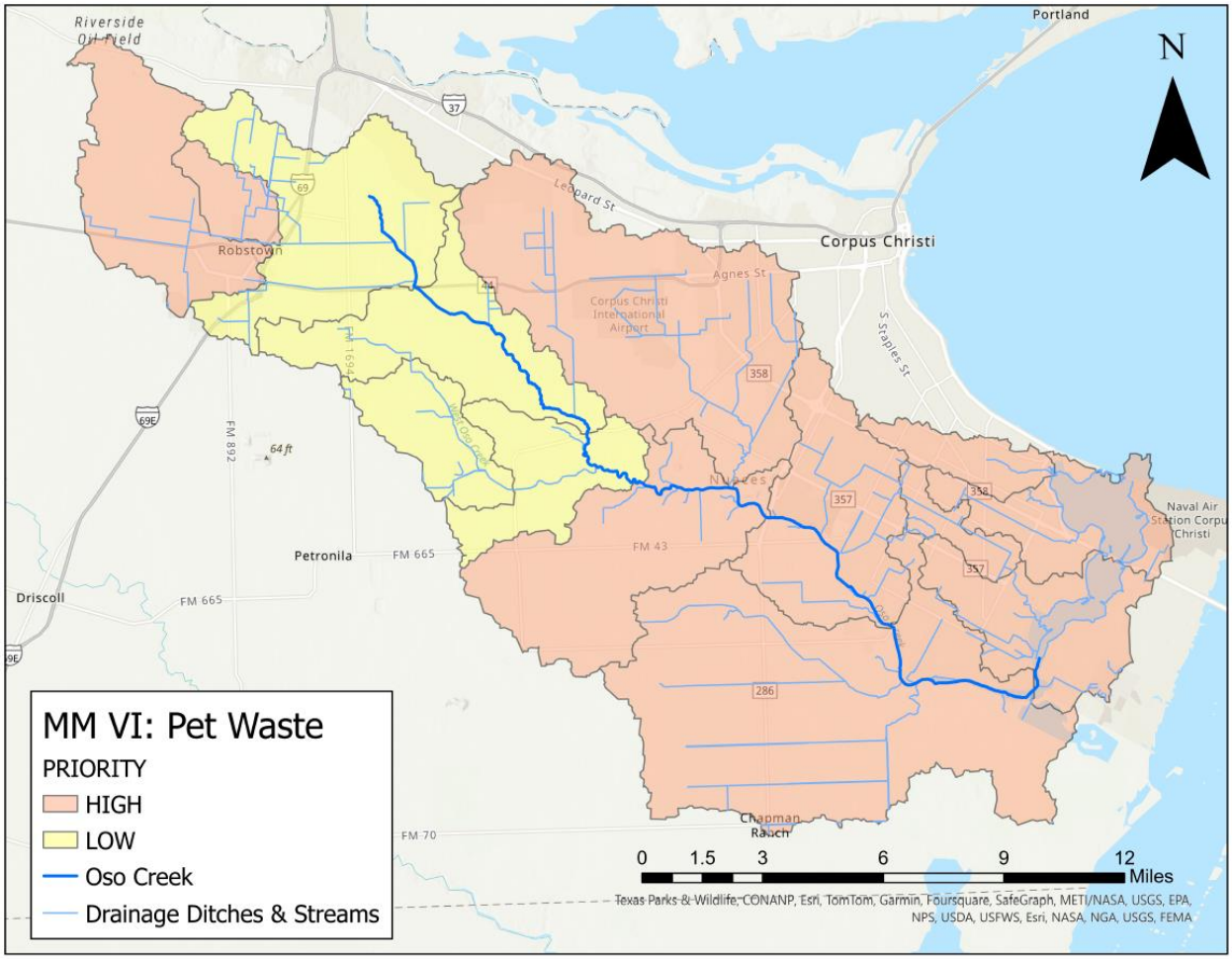


**Figure 10. Priority Areas for Oso Management Measure 6**

# Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between the City of Corpus Christi, the City of Robstown, Nueces County, Oso work groups, local non-profit organizations (e.g., CBBEP), CCN holders, AgriLife Extension, the watershed coordinator, and other local stakeholders as applicable, will be beneficial to implementing this management measure.

## Technical Assistance

Technical resources and expertise may come from city and county staff, and professional service contracts for the study, acquisition, design, construction, and related tasks needed to implement pet waste management in additional parks, in the Oso watershed. City and county staff will be needed as appropriate for installation and maintenance activities.

Technical resources needed for pet waste ordinances would include supporting the legal and political logistics of developing, adopting, and implementing a pet waste ordinance for the cities included in this plan.

Additionally, continuing implementation would require training and education for enforcement personnel. This is expected to be within the capacity of a city's existing staff. Examples of ordinances from similarly sized cities are available through Municode[25].

Educational resources available for pet waste include Texas Water Resources Institute's (TWRI) Lone Star Healthy Steams Program, EPA's NPS Outreach Toolbox on pet care, TCEQ's NPS Pollution Public Education, Austin Watershed Protection Department's Scoop the Poop campaign, and Houston-Galveston Area Council's Pet Waste Program.

## Financial Assistance

Financial resources will be needed for developing the ordinance and its subsequent enforcement. Identified funding sources are internal city revenues (City of Corpus Christi and City of Robstown), with support from CBCOG. Their support is intended to be funded through 319(h) grants or local funds. Development and funding for educational outreach about the new ordinance would also need to be considered. Revenue for the program may be supplemented by fines or fees associated with violations. Resources to potentially fund this management measure include:

- **CMP:** Local stakeholders may submit grant applications for funding to TGLO's CMP. The Commissioner of TGLO solicits applications for projects that address environmental concerns within the coastal zone and promote sustainable economic development.
- **CWA Section 319(h) NPS Grant Program:** Local stakeholders should pursue funding for urban stormwater education and outreach and for urban BMP installation through TCEQ's CWA Section 319(h) Grant Program.

[25] https://library.municode.com/

- **EEG:** Under the EEG Program, EPA seeks grant proposals from eligible applicants to support EE projects that promote environmental stewardship and help develop knowledgeable and responsible students, teachers, and citizens. This grant program provides financial support for projects that design, demonstrate, or disseminate environmental education practices, methods, or techniques as described in the EEG Program solicitation notices.
- **Urban Waters Small Grants:** The objective of the Urban Waters Small Grants from EPA is to fund projects that will foster a comprehensive understanding of local urban water issues, identify and address these issues at the local level, and educate and empower the community. In particular, the Urban Waters Small Grants Program seeks to help restore and protect urban water quality and revitalize adjacent neighborhoods by engaging communities in activities that increase their connection to, understanding of, and stewardship of local urban waterways. The estimated costs for implementing Management Measure 6 are based on the installation of one pet waste station per CCN at $3,500 each and providing outreach and education materials to watershed residents on pet waste and water quality for the duration of this plan.
- **Clean Water State Revolving Fund Loan Program:** A program offered by the TWDB that provides low-cost financial assistance for planning, acquisition, design and construction of wastewater, reuse and stormwater infrastructure.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- the number of pet waste stations installed,
- the number of educational materials developed and delivered,
- the number of participants at workshops and/or events related to pet waste,
- the number of “No Poop” pledges signed, and
- the number of pet waste ordinances developed, adopted and implemented.

## Monitoring Component

Programmatic monitoring of this implementation measure will be conducted through the tracking of the number of pet waste stations installed and ordinances adopted. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure.

## Implementation Schedule

**Year 1:**

- Submit proposals for funding of pet waste stations and educational material delivery.
- Install and maintain one pet waste collection station per CCN.
- Develop and deliver education and outreach materials to pet owners.
- Develop a proposal to strengthen current animal control ordinances relating to removal and disposal of pet waste.

**Years 2-5:**

- Install and maintain one pet waste collection station per CCN annually.
- Develop and deliver education and outreach materials to at least 2,500 residents.
- Conduct an urban pollution workshop.
- Adopt more stringent animal control ordinances relating to removal and disposal of pet waste.
- Provide five-year Management Measure 6 progress report.

## Estimated Load Reductions

Estimating an expected load reduction from education and outreach materials is inherently difficult because the reach and effectiveness of programs can be uncertain. Potential load reduction calculations are based on the waste of 24,422 dogs in the watershed. If this management measure can eliminate at least 40% of the existing dog's waste in the watershed, then 171,135.36 billion cfu of Enterococcus could be removed from the watershed per year.

$$Load_{pw} = N_{pw} \times Load\ Rate \times E_{pw} \times 365\ days/year$$

Where:

$Load_{pw}$ = estimated load reduction from picking up pet waste, 171,135.36 billiion cfu/year.

$N_{pw}$ = 9,768, Number of dogs in the watershed to be managed in the watershed (TCEQ, 2017).

***Load Rate*** = 15%, percent of dog pet waste that reaches the water body (Hyer & Moyer, 2004).

$E_{pw}$ = .32 billion cfu/day, Enterococci produced per dog per day (Wright et al. 2009).

**Table 44. Summary Management Measure 6: Promote Proper Management of Pet Waste**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | Unmanaged pet waste |
| **Potential Load Reduction** | 171,135.36 billion cfu/year |
| **Technical and financial Assistance** | Technical assistance could include the city and county staff as appropriate, established pet waste programs through TWRI, City of Austin, or H-GAC. Financial assistance could consist of the CWA Section 319(h) Grants (TCEQ) |
| **Educational Component** | Development of an education and outreach program to broadly promote adoption of pet waste ordinances for the Cities of Corpus Christi and Robstown. Provide education and outreach materials to pet owners about bacteria pollution, and how pet waste can increase pollution in water bodies. |

| | |
|---|---|
| **Schedule of Implementation** | • **Year 1:** Submit proposals for funding of pet waste stations and educational material delivery. Install and maintain one pet waste collection station per CCN. Develop and deliver education and outreach materials to pet owners. Develop a proposal to strengthen current animal control ordinances relating to removal and disposal of pet waste.<br>• **Years 2**-5: Install and maintain one pet waste collection station per CCN annually. Develop and deliver education and outreach materials to at least 2,500 residents. Conduct an urban pollution workshop. Adopt more stringent animal control ordinances relating to removal and disposal of pet waste. Provide five-year Management Measure 6 progress report. |
| **Interim, Measurable Milestones** | • Number of pet waste stations installed.<br>• Number of educational materials developed and delivered.<br>• Number of participants at workshops and/or events related to pet waste.<br>• Number of "No Poop" pledges signed. |
| **Monitoring Component** | **Programmatic:** Track the number of pet waste stations installed. Five-year report. |
| **Responsible Parties** | Watershed coordinator, Cities of Corpus Christi and Robstown, Nueces County, CCN holders, watershed stakeholders, AgriLife Extension, veterinarians, pet organizations and rescue organizations. |

# Management Measure 7. Promote, Develop and Implement Actions to Restore and Repair Riparian Zones

This management measure focuses on restoring riparian zones within the priority areas of the Oso watershed. Riparian corridors are ecosystems that extend from both sides of a stream or river that serve as important habitat for many plants and animals.

Riparian habitats reflect interactions between aquatic and terrestrial components of a landscape, and are where hydrology, vegetation, and soils come together on a stream to influence physical function. These functions include dissipation of stream energy, stabilization of banks, trapping of sediment, building and enlarging of floodplains, storage of floodwater, recharge of groundwater, and sustenance of base flows. Properly functioning riparian areas are in a state of balance, and a stream can get out of equilibrium when the amount of water, sediment, and vegetation is changed due to natural or man-made disturbances. Properly functioning riparian areas provide ecosystem services such as high-quality habitat for both aquatic and terrestrial species, dissipation of flood energy and reduced downstream flood intensity and frequency, filtering of debris and nutrients to improve water quality and dissolved oxygen levels in the aquatic system, stable banks, which reduce erosion and protect ownership boundaries, and many other ecosystem services.

The riparian needs of the Oso watershed can be measured through arial photos of existing corridors or a GIS mapping project. The establishment of a modeling project to develop a methodology for obtaining an optimal amount of restored land, square milage needed, and areas available to be restored could be an important tool in achieving the goals of this management measure. Once more information is collected

on the riparian areas in the watershed programs, such as tree plantings and more, can be developed and implemented.

Municipalities within the watershed may also explore the adoption of standards for platting and development codes to preserve riparian corridors and vegetated buffer strips or setbacks along creeks and natural or manmade drainage swales or channels in the Oso watershed. Without having enforceable ordinances in place, preservation of riparian corridors is voluntary. These ordinances are critical, especially in high use public areas or areas that produce increased runoff during rains. Enforcement by local governments is necessary after ordinances have been adopted. Stakeholders, residents, and local organizations can encourage developers to include riparian corridor preservation provisions in new and existing by-laws.

## Education Component

Education and outreach activities may include providing education opportunities to residents and property owners on the value of riparian habitat. The Remarkable Riparian program was initiated to provide information to Nueces River Basin landowners on the importance of riparian areas to the health and function of rivers. Some other educational opportunities include:

1. Texas Riparian and Stream Ecosystem Education Program: Offered by TWRI in cooperation with TSSWCB and other agencies. This training focuses on water quality issues including the role riparian areas play in helping improve and protect water quality.

2. Develop and install interpretive centers/kiosks: Kiosks with maps, videos, and a Google Earth flyover of Oso Creek and Oso Bay could be displayed in strategic locations. The public outreach campaign would inform the public of the importance of the Oso watershed and protecting water quality.

3. Incentivize and encourage restoration of riparian areas along the bank through the development and implementation of a community led program. This program could fund workday events to restore riparian areas, help fund city parks programs to improve vegetation, and create a citizen tree planting program.

4. Develop recreation and tourism opportunities along Oso Creek and within the Oso watershed, showcasing the multiple values of the watershed.

## Priority Areas

Priority areas for this management measure have been divided into an implementation timeline described below for the next five years, as shown in in Figure 11.

- Year 1 through 3- Oso Creek, including all La Volla Creek drainages and adjacent areas and areas adjacent to row crop lands, including tributaries.
- Year 4– Priority Area 5, including all tributaries.
- Year 5- All Priority Areas.

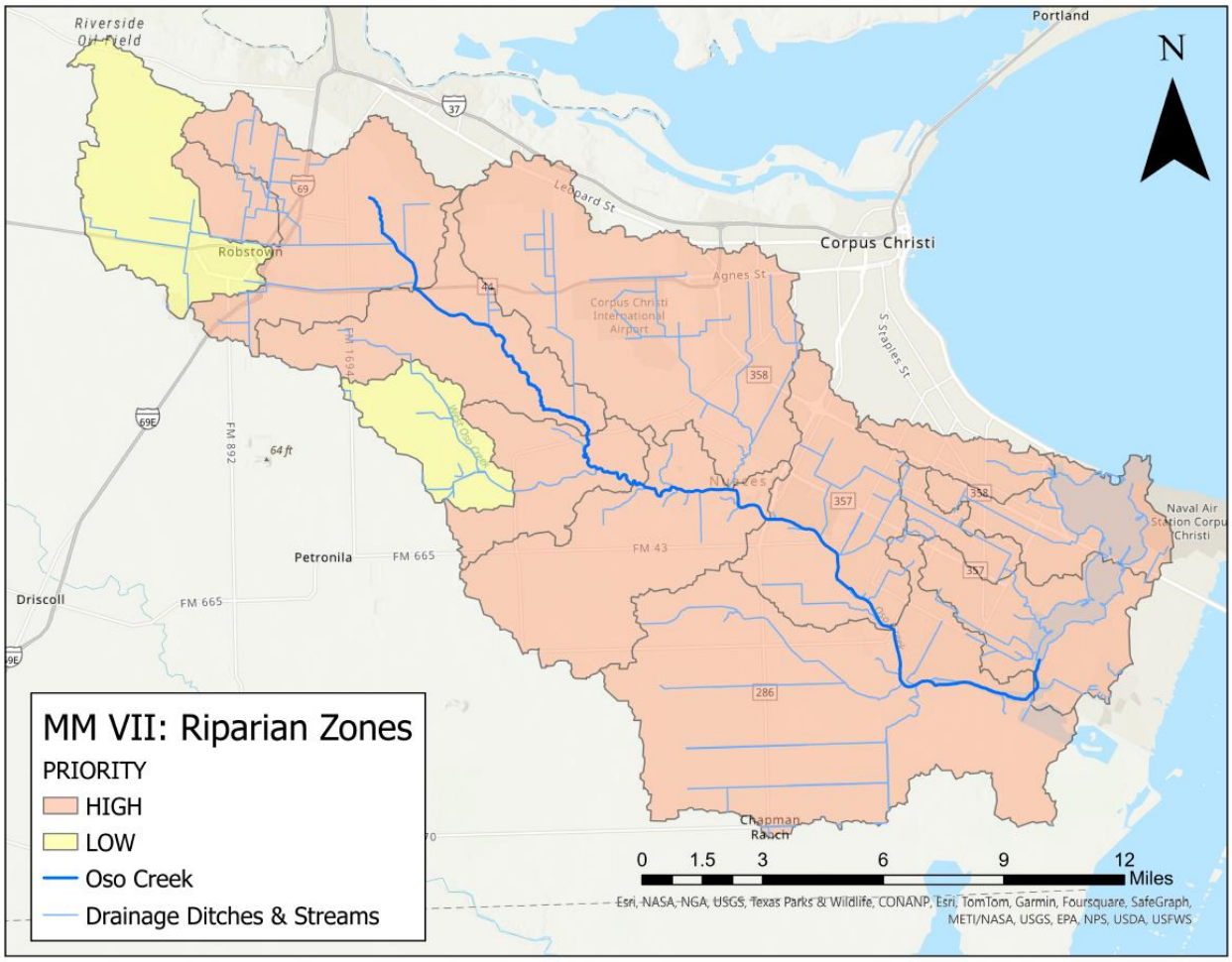


**Figure 11. Priority Areas for Oso Management Measure 7**

# Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between the City of Corpus Christi, the City of Robstown, Nueces County, CBCOG, Oso work groups, local non-profit organizations (e.g., CBBEP), NRA, AgriLife Extension, the watershed coordinator, and other local stakeholders as applicable, will be beneficial to implementing this management measure.

## Technical Assistance

Technical assistance sources for this management measure can come from the following entities and programs. Texas Riparian Association is a statewide organization that offers riparian education in the form of webinars and in-person classes to promote the protection and preservation of rivers and creeks. States, territories, authorized tribes, and the public can use EPA's National Management Measures to Protect and Restore Wetlands and Riparian Areas for the Abatement of Pollution[26] document as a guide to create management measures to reduce NPS by protecting and restoring wetland and riparian areas. TAMU created an educational

[26] www.epa.gov/sites/default/files/2015-10/documents/wetmeasures_guidance.pdf

document titled Riparian Restoration on Farms and Ranches in Texas[27] that can be used to learn more about the benefits of riparian areas and how they can be managed for better agricultural and wildlife production. TSSWCB's Riparian and Ecosystem Education Program is a statewide program that facilitates the promotion of healthy watersheds and improve water quality through the offering of riparian and stream ecosystem education programs. The local Master Naturalist Program offers education, outreach and services dedicated to the beneficial management of natural resources and natural areas through their riparian classes.

### Financial Assistance

Financial assistance sources include:

- **Supplemental Environmental Projects**: The SEP program, administered by TCEQ, directs fines, fees, and penalties for environmental violations toward environmentally beneficial uses. Through this program, a respondent in an enforcement matter can choose to invest penalty dollars into improving the environment, rather than paying into the Texas General Revenue Fund. Program dollars may be directed to OSSF repair, trash dump clean up, and wildlife habitat restoration or improvement, among other things. Program dollars may be directed to entities for single, one-time projects that require special approval from TCEQ or directed to entities (such as Resource Conservation and Development Councils) with pre-approved "umbrella" projects.
- **CWA Section 319(h) Grants**: EPA provides grant funding to Texas to implement the State's approved NPS Management Program. The EPA-approved Texas program provides the framework for determining which activities are eligible for funding under CWA Section 319(h). In general, these activities include non-regulatory programs and are related to controlling NPS pollution. EPA-approved NPS programs cover costs associated with technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of specific NPS projects. The funds require a 40% match and may be used to support education and outreach.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- the number of educational events held,
- the number of attendees at educational events,
- the number of plans created for restoration,
- the number of acres restored, and
- periodic aerial photography of the Oso watershed to document riparian restoration progress.

## Monitoring Component

The programmatic implementation progress for this management measure will be tracked through the number of educational events held, the creation of a GIS project to

[27] https://bexar-tx.tamu.edu/files/2012/07/Riparian-Restoration-on-Farms.pdf

map existing riparian corridors, creation of a model to estimate the amount of area that needs restoration, the number of acres restored, and the number of planting programs conducted. Other methods of monitoring progress can be developed by stakeholders. A five-year report will be submitted to TCEQ, summarizing all activities related to this management measure.

## Implementation Schedule

**Year 1:**

- Conduct one Riparian Workshop with NRA and hold or attend other education events. (Offer information on waterway rights at these workshops for local property owners.)

**Year 2:**

- Develop up to four restoration plans focused on restoring riparian habitat in the Oso watershed.
- Explore the adoption of standards in platting and development codes, ordinance, and court orders to preserve riparian corridors and vegetated buffer strips or setbacks along creeks and natural and manmade drainage swales and channel in the Oso Watershed.

**Years 3-5:**

- Conduct one riparian workshop or education event annually.
- Develop four restoration plans annually.
- Develop and propose a city ordinance to restrict development close to Oso Creek and Oso Bay banks and require and enforce a designated number of feet of riparian corridor. This would be accomplished through implementing set back ordinances for mowing from creeks and drainage swales, including residential and agricultural areas. An example of this would be the City of Austin's Creekside Restoration Program[28].
- Incentivize and encourage restoration of riparian areas along the bank through the development and implementation of a community led program. This program could fund workday events to work to restore riparian areas, help fund city parks programs to improve vegetation, and create a citizen tree planting program.
- Conduct a more expansive riparian evaluation through a GIS mapping project.
- Establish a modeling project to develop a methodology for obtaining an optimal amount of restored land, square milage needed, and areas available to be restored.
- Develop recreation and tourism opportunities along Oso Creek and within the Oso Watershed, showcasing the multiple values of the watershed.
- Provide five-year Management Measure 7 progress report.

[28] https://www.austintexas.gov/department/creekside-restoration

## Estimated Load Reductions

An estimated load reduction was not calculated for this management measure due to this management measure activity only planning implementation for promotion, outreach and education events.

**Table 45. Summary Management Measure 7: Promote, Develop and Implement Actions to Restore and Repair Riparian Zones**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | Contaminants conveyed by stormwater runoff over degraded or damaged riparian zones. |
| **Potential Load Reduction** | N/A |
| **Technical and Financial assistance** | Technical assistance could include Texas Riparian Association, National Management Measures to Protect and Restore Wetlands and Riparian Areas for the Abatement of NPS Pollution (EPA), Riparian Restoration on Farms and Ranches in Texas (TAMU). Financial assistance could consist of CWA Section 319(h) Grants (TCEQ and/or TSSWCB) and SEP. |
| **Educational Component** | Provide residents and property owners education through multiple programs, including Remarkable Riparian (NRA), Riparian & Stream Ecosystem Education Program (TWRI & TSSWCB), and other educational programs offered through other agencies. Develop and install interpretive centers/kiosks with maps, videos, and Google Earth flyover of the Oso watershed displayed in strategic locations. Public outreach campaign of the Oso watershed's importance. |
| **Schedule of Implementation** | • **Year 1:** Conduct one Riparian Workshop with NRA and hold/attend other education events.<br>• **Year 2**: Develop up to four restoration plans. Explore the adoption of standards in platting and development codes, ordinance, and court orders to preserve riparian corridors.<br>• **Years 3-5**: Continue as above with up to one workshop or education event, and four restoration plans annually. Develop and propose a city ordinance to restrict development close to Oso Creek and Oso Bay banks and require a designated number of ft of riparian corridor. Conduct workday events to work to restore riparian areas. Help fund city parks programs to improve vegetation and create a citizen tree planting program. Conduct a more expansive riparian evaluation through a GIS mapping and modeling project. Develop recreation and tourism opportunities. Provide five-year Management Measure 7 progress report. |
| **Interim, Measurable Milestones** | • Number of education events.<br>• Numbers of attendees of workshops and other educational events.<br>• Number of restoration plans created.<br>• Numbers of acres restored.<br>• Periodic aerial photography of the Oso watershed. |
| **Monitoring Component** | • **Programmatic:** Track the number of educational events held, the creation of a GIS project to map existing riparian corridors, creation of a model to estimate the amount of area that needs restoration, the number of acres restored, and the number of planting programs conducted. Five-year report. |
| **Responsible Parties** | Watershed stakeholders, watershed coordinator, AgriLife Extension and NRA. |

# Management Measure 8. Conduct Water Quality Research, Monitoring and Sampling

In order to assess progress towards reducing bacterial loading in the Oso watershed, water quality monitoring will be needed in Oso Creek and Oso Bay on a routine basis.

Evaluation of monitoring results will be used to identify potential changes within the priority areas, as depicted in Figure 12, that could improve effectiveness of the I-Plan.

Monitoring and annual evaluations will determine if the I-Plan or any of its parts are complete, require a longer time frame, or require revision. Every five years, as resources are available and with stakeholder participation, a more in-depth evaluation will be completed. Two types of water quality monitoring are proposed: bacteria baseline water quality monitoring (pre-rain event) and stormwater water quality monitoring for bacteria and streamflow (during and post-rain event).

These monitoring measures will form the basis for potential research projects related to understanding the causes, sources, and solutions to high bacteria levels in the Oso watershed, especially as driven by NPS pollution. Conclusions derived from post-implementation water quality monitoring data will be an important indicator of whether implementation activities are resulting in the desired reduction of bacteria loading. Additionally, a bacteria source tracking study should be conducted to better understand the specific sources of bacteria in the Oso watershed. The results of this research will provide essential information to determine strategic modifications to management measures outlined in this plan.

## Education Component

The educational component of this management measure will provide resources for educational workshops and outreach events to volunteers through the Texas Stream Team (TST). Educational goals will include educating the public on citizen science, water quality, environmental stewardship, water quality sampling, and more. Educational resources and training will also be offered to students who attend local universities. Education for this management measure can also come from demonstrations of an Oso watershed model in up to three outreach events in Years 1-5.

## Priority Areas

The Oso Creek watershed is the priority area for this management measure; however, the focus of monitoring will first be given to areas upstream of the saltwater line in the Oso Creek watershed (Year 1). Additional priority locations will be determined after initial sampling is complete and analyzed (Years 2-5).

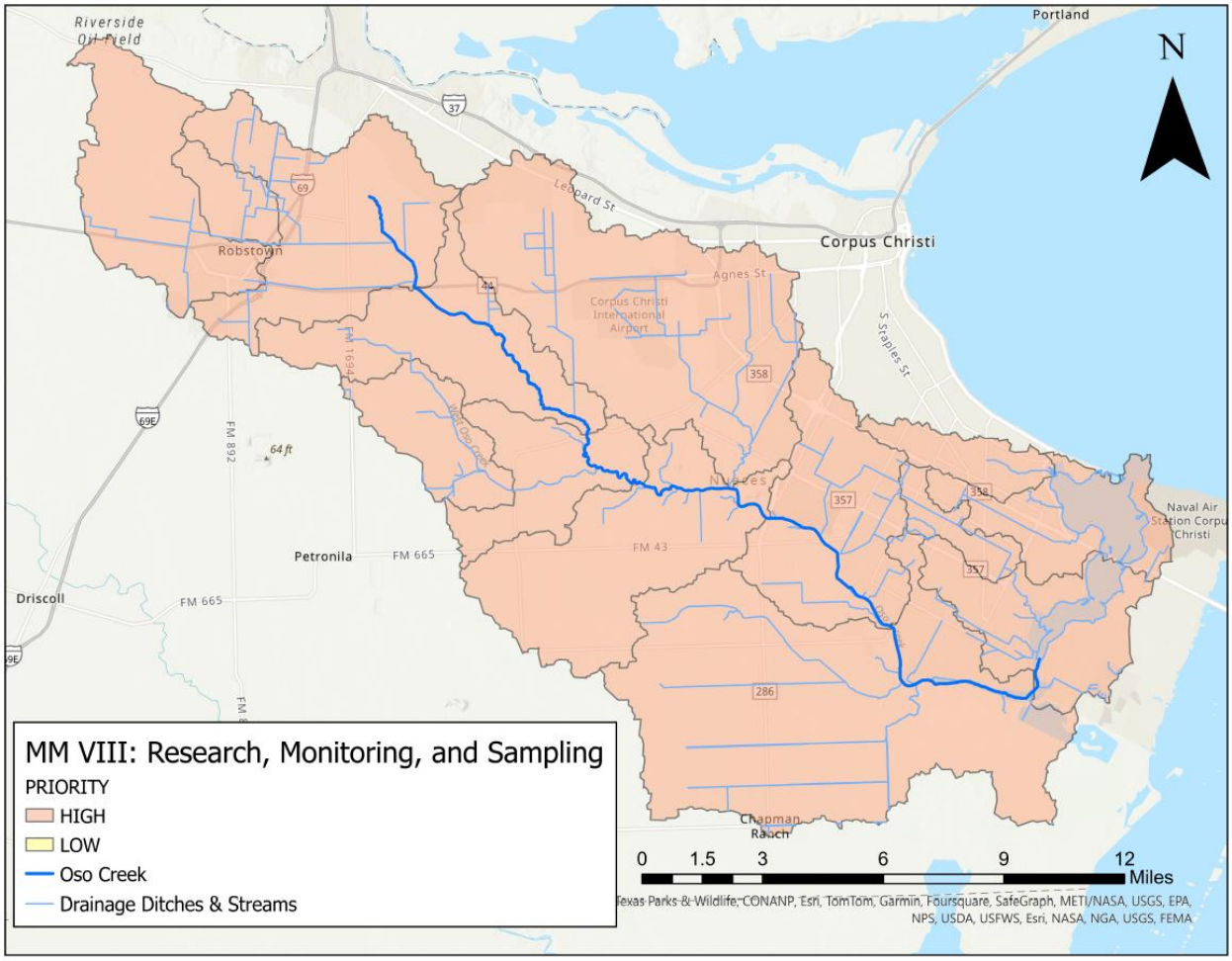


**Figure 12. Priority Areas for Oso Management Measure 8**

# Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between the CBCOG, TAMUCC, NRA, Independent School Districts, local colleges, Oso work groups, local non-profit organizations (e.g., CBBEP), the watershed coordinator, and other local stakeholders as applicable, will be beneficial to implementing this management measure.

## Technical Assistance

The entities mentioned in this section provide sources of technical assistance for this management measure, but technical assistance sources for this management measure need not be limited to these entities. TAMUCC, the City of Corpus Christi, CBBEP, NRA, TCEQ, EPA, and other universities and agencies as appropriate, may provide technical assistance.

## Financial Assistance

Financial assistance sources include:

- **Supplemental Environmental Projects:** The SEP program, administered by TCEQ, directs fines, fees, and penalties for environmental violations toward environmentally beneficial uses. Through this program, a respondent in an enforcement matter can choose to invest penalty dollars into improving the environment, rather than paying into the Texas General Revenue Fund. Program dollars may be directed to OSSF repair, trash dump clean up, and wildlife habitat restoration or improvement, among other things. Program dollars may be directed to entities for single, one-time projects that require special approval from TCEQ or directed to entities (such as Resource Conservation and Development Councils) with pre-approved "umbrella" projects.
- **CWA Section 319(h) Grants:** EPA provides grant funding to Texas to implement the State's approved NPS Management Program. The EPA-approved Texas program provides the framework for determining which activities are eligible for funding under CWA Section 319(h). In general, these activities include non-regulatory programs and are related to controlling NPS pollution. EPA-approved NPS programs cover costs associated with technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of specific NPS projects. The funds require a 40% match and may be used to support education and outreach.

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- the number of grants received to help conduct additional sampling,
- the number of sampling events,
- the development of reports based on sampling data and analysis, and
- the number of presentations developed and delivered based on additional water quality sampling data and analysis, and their subsequent reports on findings.

## Monitoring Component

The monitoring component for this management measure should continue and expand TST and Citizen Science monitoring in the watershed. A Regional TST volunteer monitoring group for the Coastal Bend Area has been developed by the CCS, NRA, and CBBF with TST at The Meadows Center for Water and Environment. Programmatic monitoring of this management measure will consist of tracking the number of grants received, number of additional sampling events completed, and the number of educational outreach activities completed.

## Implementation Schedule

**Year 1:**

- Obtain grants to help conduct additional bacteria sampling in the Oso watershed.

**Year 2:**

- Expand bacteria monitoring sampling site locations and frequency.

- Develop and implement a bacterial source tracking study in the Oso watershed and create GIS layers and graphs from the results of the study.

**Year 3-5:**

- Identify, implement, and evaluate methods to remove bacteria with GI and other engineering solutions.
- Develop an Oso Creek stream hydrology report.
- Develop and deliver educational presentations based on water quality sampling data and analysis, and their subsequent reports on findings.
- Develop an Oso watershed model to be used at educational events in the watershed.

## Estimated Load Reductions

An estimated load reduction was not calculated for this management measure due to this management measure only planning research and monitoring at this time.

**Table 46. Summary Management Measure 8: Conduct Water Quality Research, Monitoring and Sampling**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | N/A |
| **Potential Load Reduction** | N/A |
| **Technical and Financial Assistance** | Technical assistance could include TAMUCC, the City of Corpus Christi, CBBEP, NRA, TCEQ, EPA and other universities and agencies as appropriate. Financial assistance could consist of CWA Section 319(h) Grants (TCEQ and/or TSSWCB) and SEP funds. |
| **Educational Component** | Continue and expand TST and Citizen Science monitoring. Volunteer Monitoring—Regional TST volunteer monitoring group for the Coastal Bend Area has been developed by the CCS, NRA, and CBBF with TST at The Meadows Center for Water and Environment. Demonstrate the Oso Watershed model in up to three outreach events years 1-5. |
| **Schedule of Implementation** | • **Year 1:** Obtain grants to help conduct additional bacteria sampling in the Oso watershed.<br>• **Year 2:** Expand bacteria monitoring sampling site locations and frequency. Develop and implement a bacterial source tracking study. Create GIS layers and graphs from the results of the bacteria source tracking study.<br>• **Year 3-5:** Identify, implement, and evaluate methods to remove bacteria with GI and other engineering solutions. Develop an Oso Creek stream hydrology report. Develop and deliver educational presentations based on additional water quality sampling data and analysis, and their subsequent reports on findings. Develop an Oso watershed model to be used at educational events in the watershed. |
| **Interim, Measurable Milestones** | • Number of grants received to help conduct additional sampling.<br>• Number of sampling events.<br>• The development of reports based on sampling data and analysis.<br>• Number of presentations developed and delivered based on additional water quality sampling data and analysis and their subsequent reports on findings. |

| | |
|---|---|
| **Monitoring Component** | • **Programmatic:** Track the number of grants received, number of additional sampling events completed, and the number of educational outreach activities completed.<br>• **Environmental:** Routine ambient monitoring conducted by TCEQ and River Authority partners can be used to assess the condition of the receiving water bodies, along with volunteer monitoring. |
| **Responsible Parties** | TAMUCC-CCS, CBBEP, NRA, Independent School Districts and the watershed coordinator. |

# Management Measure 9. Promote, Develop and Implement Stormwater and GI Programs in the Oso Watershed

Stormwater runoff is the dominant mechanism by which NPS fecal loads are transported to receiving waters. Management of stormwater to reduce bacteria can be achieved with non-structural BMPs like riparian zone enhancement, or with structural BMPs like sedimentation or filtration basins. Fecal bacteria are strongly associated with stream sediment (Byappanahalli and Ishii, 2014), and removal of sediment from stormwater runoff may reduce bacteria loads. Structural stormwater BMP effectiveness in bacteria removal is variable depending on retention time and mechanism of treatment.

The City of Corpus Christi has completed several planning documents that provide guidance for the development of stormwater conveyances in the Oso watershed. These documents include the Oso Parkway Plan[29], as well as other land use master planning documents currently in preparation. The goal of this management measure is to expand the use of GI and LID techniques in developments within the City of Corpus Christi and the Oso watershed to reduce bacteria loading in NPS runoff. To achieve this goal, education outreach activities can be used to teach the public and developers about the benefits of GI and LID. Some of these activities include educating residents, homeowners, and landowners about environmental problems associated with manicured lawns along creek banks; maintenance of rights of way areas; the value of vegetated green strips to slow the flow of stormwater; and the identification of functional plant groups and how to protect them in their communities. Additionally, the nonprofit Keep Austin Beautiful operates an Adopt-a-Street Program, which helps keep City of Austin streets clean and litter-free. A similar program could be developed and implemented in the Oso watershed.

Many creative solutions have been used since the development of GI and LID technology. Some of these solutions are xeriscape programs, rain barrel programs, GI, permeable pavement, pavers, green roofs, incorporation of ponds in new developments, treated detention basins, rain gardens, and the conversion of drainage ditches to vegetated swales. Communities can use some or all of these techniques to help reduce stormwater runoff and improve water quality. A tax incentive program to encourage the implementation of GI projects by municipalities, citizens and developers

[29] www.cctexas.com/sites/default/files/osoparkwayplan.pdf

should also be developed and proposed to encourage the adoption of GI and/or LID practices in new developments. Standards that require engineering Request for Proposals (RFPs) to include designated GI or LID techniques should also be developed and proposed for adoption to ensure new developments incorporate these practices into their designs.

Lastly, a public health advisement protocol should be developed to warn the public of periodically elevated bacteria levels in drainage ditches, as anticipated by weather forecasts for rain, as well as warnings during and immediately after rainfall.

## Education Component

Targeting both homeowners and elected officials, educational and outreach programs will be delivered that highlight various practices designed to reduce the impact of stormwater on water quality. The programs will also be designed to help local governments develop strategies for reducing potential bacteria loadings to local water bodies from urban stormwater. Some local entities may use this information, and the technical and financial assistance provided by state and federal agencies, to develop comprehensive urban stormwater assessments.

These programs will be implemented through a variety of methods including, but not limited to, PSAs, utility bill inserts, direct mailing, educational kiosks, and signage at pet waste stations in parks and at public environmental events (e.g., Earth Day celebrations). These educational events will include seminars on LID and retrofitting strategies that can be implemented on existing stormwater structures or incorporated into the designs of new structures. Texas Watershed Steward workshops will be provided, and surveys will be conducted to determine the public's knowledge base of stormwater issues.

## Priority Areas

Priority areas for this management measure have been divided into an implementation timeline described below for the next five years, as shown in Figure 13. Year 1 of implementation will focus on the City of Corpus Christi and City of Robstown stormwater conveyances that empty into Oso Creek and Bay. Years 2-5 of implementation will focus on agricultural lands improvement and continuing to improve city development practices.

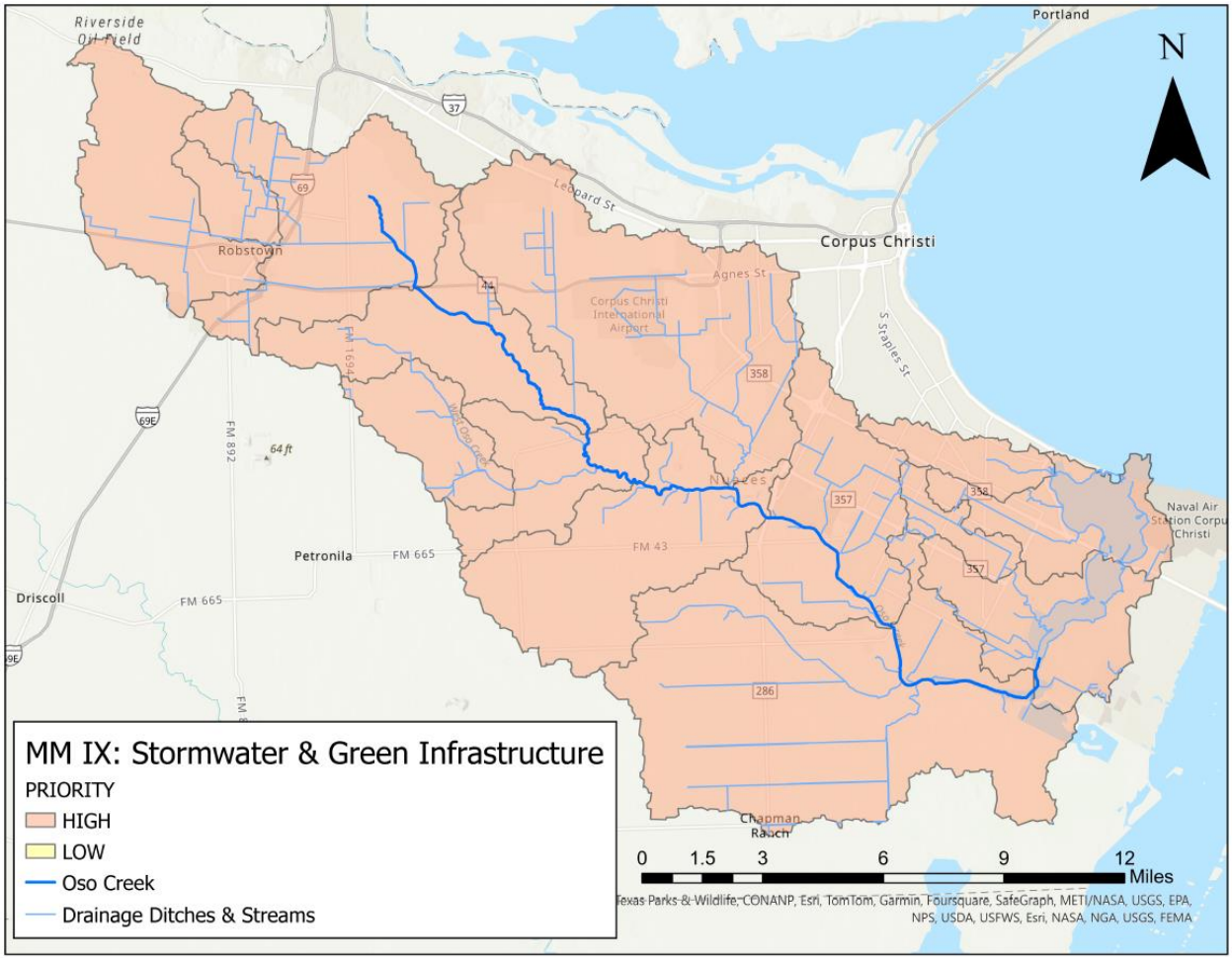


**Figure 13. Priority Areas for Oso Management Measure 9**

# Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts. Coordination between the City of Corpus Christi, the City of Robstown, Nueces County, Oso work groups, AgriLife Extension, the watershed coordinator, local landowners, developers, and other local stakeholders as applicable, will be beneficial to implementing this management measure activity.

## Technical Assistance

Technical assistance for Management Measure 9 is available as needed from TCEQ Region 14. City of Corpus Christi and City of Robstown staff will be needed throughout the planning process. There are a multitude of existing technical resources for education and outreach. Some of which include the following programs. The Gutter to Gator Stormwater Management Workshop, offered by Texas A&M AgriLife Extension Service Sea Grant Program, that teaches the natural techniques to clean and conserve stormwater for humans and wildlife at any scale. The Texas Well Owner Network educational training offered by AgriLife Extension in cooperation with TSSWCB and other agencies for Texas residents who depend on household wells for their drinking

water needs. The Texas Watershed Steward program created by AgriLife Extension and the TSSWCB to provide science-based, watershed education to help citizens identify and take action to address local water quality impairments. These citizens learn about the nature and function of watersheds, potential impairments, and strategies for watershed protection.

### Financial Assistance

Financial assistance sources include:

- **CWSRF**: Through TWDB, the CWSRF program provides low-interest loans to local governments and service providers for infrastructure projects that include stormwater BMPs. The loans can spread project costs over a repayment period of up to twenty years. Repayments are cycled back into the fund and used to pay for additional projects. Needed capital investments to meet permit requirements are unknown and not estimated.
- **CWA Section 319(h) Grants**: EPA provides grant funding to Texas to implement the State's approved NPS Management Program. The EPA-approved Texas program provides the framework for determining which activities are eligible for funding under CWA Section 319(h). In general, these activities include non-regulatory programs and are related to controlling NPS pollution. EPA-approved NPS programs cover costs associated with technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of specific NPS projects. (EPA, 2022)

## Measurable Milestones

Contingent on receipt of proposed project funding, the measurable milestones are:

- the number of GI and/or LID projects developed and implemented,
- the development and implementation of a tax incentive program for businesses or homes to implement GI and/or LID,
- the development and implementation of a program similar to Keep Austin Beautiful's Adopt-a-Street Program,
- the number of adopted or amended city ordinances regarding GI and/or LID, and
- the number of education and outreach events conducted.

## Monitoring Component

Environmental monitoring for this management measure is the responsibility of the MS4 permittee. The Cities of Corpus Christi and Robstown will be responsible for monitoring as detailed in their approved SWMP. Programmatic monitoring of this management measure will consist of tracking the number of education and outreach events conducted, the number of new developments that used LID and GI techniques and the number of ordinances that pertain to LID and GI that are adopted.

# Implementation Schedule

**Year 1:**

- Develop public health advisement protocols to warn the public of periodically elevated bacteria levels in drainage ditches, as anticipated by weather forecasts for rain, as well as warnings during and immediately after rainfall.
- Conduct education and outreach activities on the importance of stormwater runoff on water quality and GI/LID techniques.
- Propose new city ordinances or amendments to encourage GI and LID implementation in new developments.

**Year 2:**

- Develop a tax incentive program to encourage the implementation of GI projects by municipalities, citizens and developers.
- Propose standards that require Engineering RFPs to include GI or LID techniques.
- Adopt a program similar to Austin's Adopt-a-Street Program, to keep streets clean and reduce NPS runoff.
- Conduct at least one education and outreach activity.

**Years 3-5:**

- Expand the public health advisement protocols, city ordinances, tax incentive programs, RFP standards and the Adopt-a-Street Program to all areas of the Oso watershed.
- Continue education and outreach activities annually.

# Estimated Load Reductions

An estimated load reduction was not calculated for this management measure due to this management measure activity only planning implementation for promotion, outreach and education events.

**Table 47. Summary Management Measure 9: Promote, Develop and Implement Stormwater and GI Programs in the Oso Watershed**

| Key Element | Summary |
|---|---|
| **Causes and Sources** | Stormwater runoff |
| **Potential load reduction** | N/A |
| **Technical and financial assistance** | Technical assistance for this management measure is available as needed from TCEQ Region 14, AgriLife Extension and TSSWCB. Staff from the cities of Corpus Christi and Robstown will be needed throughout the planning and plan implementation processes. Financial assistance could consist of CWA Section 319(h) Grants and the State Clean Water Revolving Fund. |
| **Educational component** | Targeting both homeowners and elected officials, educational and outreach programs will be delivered that highlight various practices designed to reduce the impact of stormwater on water quality. The programs will also be designed to help local governments develop strategies for reducing potential bacteria loadings to local water bodies from urban stormwater. |

| | |
|---|---|
| **Schedule of implementation** | • **Year 1:** Develop public health advisement protocols to warn the public of periodically elevated bacteria levels in drainage ditches. Conduct education and outreach activities on the importance of stormwater runoff on water quality and GI/LID techniques. Propose new city ordinances or amendments to encourage GI and LID implementation in new developments.<br>• **Year 2:** Develop a tax incentive program. Propose standards that require Engineering RFPs to include GI or LID techniques. Adopt a program similar to Keep Austin Beautiful's Adopt-a-Street Program. Conduct at least one education and outreach activity.<br>• **Years 3-5:** Expand the public health advisement protocols, city ordinances, tax incentive programs, RFP standards and the Adopt-a-Street Program to all areas of the Oso watershed. Continue education and outreach activities annually. |
| **Interim, measurable milestones** | • Number of GI and/or LID projects developed and implemented by municipalities, citizens, and developers.<br>• Development and implementation of a tax incentive program for business or homes to implement GI and/or LID.<br>• Develop a program similar to Keep Austin Beautiful's Adopt-a-Street Program.<br>• Number of adopted or amended city ordinances regarding LID or GI.<br>• Number of education and outreach events conducted. |
| **Monitoring component** | • **Programmatic:** Track the number of education and outreach events conducted, the number of new developments that used LID and GI techniques and then numbers of ordinances that pertain to LID and GI adopted.<br>• **Environmental:** The Cities of Corpus Christi and Robstown will be responsible for monitoring as noted in their approved SWMP. |
| **Responsible Party** | Watershed coordinator, Cities of Corpus Christi and Robstown, Nueces County, local Non-Profits, universities and AgriLife Extension. |

# Sustainability

TCEQ, responsible parties, and other stakeholders in TMDL implementation projects periodically assess the results of the planned activities, along with other information, to evaluate the effectiveness of the I-Plan. Responsible parties and other stakeholders evaluate several factors, such as the pace of implementation, the effectiveness of BMPs, load reductions, and progress toward meeting water quality standards.

The responsible parties and other stakeholders will track progress using both measurable milestones and water quality indicators. These terms are defined as:

- **Measurable Milestone**: A measure undertaken to cause an improvement in water quality.
- **Water Quality Indicator**: A measure of water quality conditions for comparison to pre-existing conditions, constituent loadings, and water quality standards.

## Water Quality Indicators

TGLO's TBWP will continue sampling for bacteria in water in the CARP watershed throughout implementation. Additional funding will be sought to conduct supplemental monitoring in the watershed.

Follow-up monitoring will be conducted within the watershed throughout the implementation schedule. The monitoring strategy will consider the spatial and temporal aspects necessary to characterize trends in water quality that result from implementing the activities in this plan. Follow-up monitoring through the TBWP will also provide water quality data for evaluation of standards attainment. The monitoring program is expected to consist of routine sampling exercises that emphasize historical monitoring locations, with some potential modifications as needed. Water quality monitoring and data collection will occur routinely throughout the year. As stated in the TMDL report, the summer season represents the critical condition, during which time the study area has the highest levels of contact recreation. The TMDL and respective reductions are based on the critical condition.

TCEQ will assess CARP beaches every two years as part of updating the Integrated Report. If the Texas Surface Water Quality Standards criteria for contact recreation are revised or water quality changes at these beaches are observed, this I-Plan may be modified. The ultimate goal is for the impaired AUs in the CARP watershed to meet water quality standards for contact recreation. If sufficient reductions in Enterococcus are not observed, stakeholders will reevaluate the potential sources identified in the TMDL and adapt the I-Plan as appropriate.

In the Oso watershed, the CRP partner, NRA, will continue to collect monitoring data that will be evaluated by the watershed coordinator to assess impacts of management measures on water quality, , as funding and resources allow. Additional funding will be sought by the watershed coordinator to conduct supplemental monitoring in the watershed. Routine water quality monitoring activities will be conducted in Oso Creek.

## Measurable Milestones

Implementation tracking helps stakeholders to determine if progress is being made toward meeting the goals of the TMDLs and I-Plan. Tracking also allows stakeholders to identify whether specific actions are working or not and make any changes that may be necessary to get the I-Plan back on target. Measurable milestones track the completion of activities meant to reduce pollutant loadings. Schedules and milestones for this I-Plan are included in the descriptions of each management measure.

# Communication Strategy

TCEQ will work with responsible parties and other stakeholders to hold meetings or obtain annual I-Plan updates for up to five years, so stakeholders may evaluate their progress. Responsible parties and stakeholders will continue to provide annual updates and/or take part in any meetings over the five-year period to evaluate implementation efforts. At the completion of the scheduled I-Plan activities, stakeholders will assemble and evaluate the actions, overall impacts, results of their implementation efforts and decide the next steps of implementation.

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# Appendix A.
# Load Reduction Estimates

**Table A1. CARP Watershed Load Reduction Estimates**

| Measure | Description | Load Reduction |
|---|---|---|
| **Education and Outreach** | | |
| Management Measure Activity 1.1 | Promote Watershed Education and Public Awareness in Corpus Christi | N/A |
| Management Measure Activity 1.2 | Anti-Littering: "Leave It Better Than You Found It" | N/A |
| Management Measure Activity 1.3 | Pet Waste Disposal | 63,436.42 billion cfu/yr of Enterococcus |
| Management Measure Activity 1.4 | Prevent Intentional Dumping and Disposal | N/A |
| Management Measure Activity 1.5 | Slow the Flow (Low Impact Development) Initiative | N/A |
| Management Measure Activity 1.6 | Install Additional Signage to Alert the Public of Potential Health Risks at Cole Park and Ropes Park After Rain Events. | N/A |
| **Monitoring** | | |
| Management Measure Activity 2.1 | Continuing Sampling Enterococcus Levels at Cole and Ropes Park | N/A |
| Management Measure Activity 2.2 | Collect Rainfall Data Near Cole and Ropes Parks | N/A |
| Management Measure Activity 2.3 | Conduct Stormwater Outfall Flow Sampling | N/A |
| **Research** | | |
| Management Measure Activity 3.1 | Evaluate Methods to Remove Bacteria with Green Infrastructure | N/A |
| Management Measure Activity 3.2 | Bacterial Source Tracking | N/A |
| Management Measure Activity 3.3 | Evaluate the Effectiveness of Public Utilities Programs and Projects | N/A |

| Measure | Description | Load Reduction |
|---|---|---|
| Management Measure Activity 3.4 | Investigate New Data Analysis Methodologies for Assessment and Listing of Recreational Beaches on the 303(d) List | N/A |
| Management Measure Activity 3.5 | Identify Water Flow Patterns in Corpus Christi Bay at Ropes Park Using Dye Testing | N/A |
| Management Measure Activity 3.6 | Investigate Alternative Sampling Dates for the Texas Beach Watch Program | N/A |
| **Wastewater Collection System Enhancements** | | |
| Management Measure Activity 4.1 | Continue and the Enhance Existing FOG Program | 21,467.53 billion cfu/yr |
| Management Measure Activity 4.2 | Continue and Expand the Notification System for Monitoring SSOs | N/A |
| Management Measure Activity 4.3 | Continue and Expand Collection System Line Cleaning, Inspection, Repair, and Rehabilitation | 47,705.62 billion cfu/yr |
| Management Measure Activity 4.4 | Implement an Inflow and Infiltration Study | N/A |
| Management Measure Activity 4.5 | Continue Hydraulic Modeling of Collection System | N/A |
| **Stormwater Drainage System** | | |
| Management Measure Activity 5.1 | Continue Existing Stormwater Programs | N/A |
| Management Measure Activity 5.2 | Continue Drainage System Line Cleaning, Inspection, Repair and Rehabilitation | N/A |
| Management Measure Activity 5.3 | Determine Effectiveness of Stormwater Retrofits to Remove Bacteria | 2.55 billion cfu/yr |
| Management Measure Activity 5.4 | Enhance Major Outfall Assessment and Repair Program | 393.70 billion cfu/yr |
| Management Measure Activity 5.5 | Support and Encourage the Stormwater Master Plan | N/A |
| **Ordinances and Regulation Improvements** | | |

| Measure | Description | Load Reduction |
|---|---|---|
| Management Measure Activity 6.1 | Pre-Sale Inspection and Testing Program of Private Residential Sewer Laterals | N/A |
| Management Measure Activity 6.2 | Cross-Connections Inspection Program | N/A |
| Management Measure Activity 6.3 | Establishment of a Pilot Sewer Lateral Inspection and Testing Program for Commercial Property | N/A |
| Management Measure Activity 6.4 | Improved Grease Trap Standards | N/A |
| Management Measure Activity 6.5 | Strengthen Current Animal Control Ordinances Relating to Removal and Disposal of Pet Wastes | See MM Activity 1.3 |
| Management Measure Activity 6.6 | Implement Measures to Control Feral Cats, Rodents, and Nuisance Animals | N/A |
| Management Measure Activity 6.7 | Develop a Program to Advise Television News Viewers of Bacteria Danger Levels in the Water | N/A |
| Management Measure Activity 6.8 | Propose Access Restrictions to Bay Waters from City Parks and Other Bayfront City Properties During Periods of Public Health Risks | N/A |
| Management Measure Activity 6.9 | Propose, Adopt and Enforce Additional Solid Waste Ordinances | N/A |
| Management Measure Activity 6.10 | Explore Adoption of Additional LID Standards that will Reduce Stormwater Runoff from Areas of New Development or Significant Redevelopment | 16.16 billion cfu/year |

**Table A2. Oso Watershed Load Reduction Estimates**

| Measure/Action | Description | Load Reduction |
|---|---|---|
| Management Measure 1 | Identify OSSFs, Prioritize Problem Areas, and Systematically Work to Bring Systems into Compliance | 13,354,246.03 billion cfu/yr |
| Management Measure 2 | Promote, Develop and Implement Conservation Plans, Water Quality Management Plans and Wildlife Habitat Plans | 3,801.07 billion cfu/year |
| Management Measure 3 | Promote the Management of Feral Hog Populations | 2,386.30 billion cfu/year |

| Measure/Action | Description | Load Reduction |
|---|---|---|
| Management Measure 4 | Promote the Reduction of Illicit Dumping and Proper Disposal of Animal Carcasses | N/A |
| Management Measure 5 | Promote Wastewater Collection and Treatment Systems Improvements | N/A |
| Management Measure 6 | Promote Proper Management of Pet Waste | 171,135.36 billion cfu/year |
| Management Measure 7 | Promote, Develop and Implement Actions to Restore and Repair Riparian Zones | N/A |
| Management Measure 8 | Conduct Water Quality Research, Monitoring & Sampling | N/A |
| Management Measure 9 | Promote, Develop and Implement Stormwater and GI Programs in the Oso Watershed | N/A |

# Appendix B. Acknowledgements

# Acknowledgements


## CARP Members

- Philippe Tissot, Recreation
- James Klein, Environmental
- Sharon Bailey Murphy, City of Corpus Christi
- Meredith Darden, Tourism, Convention and Visitors Bureau
- Temple Williamson, City of Corpus Christi Wastewater
- Craig Thompson, Business & Industry
- Rosario Martinez, Environmental, Coastal Bend Bays & Estuary Program
- Kelly White, Academia
- Dr. William Burgin, Public Health
- Adriana Leiva, Recreation
- Florence Tissot, Recreation
- Leo Treviño, Environmental, Coastal Bend Bays & Estuary Program
- Rae Mooney, Environmental, Coastal Bend Bays & Estuary Program
- Gabriel Ramirez, City of Corpus Christi
- T.J. Carpenter, Visitors Bureau
- Daniel McGinn, City of Corpus Christi
- Ashleigh Higson, Tourism, Convention and Visitors Bureau
- Jay Reining, Environmental
- Sandra Heatherley, Homeowner
- Gerald Sansing, Homeowner
- Lillian Bass, Academia
- Preeti Shrestha, City of Corpus Christi
- Donna Rosson, Public Health
- Robert Anderson, City of Corpus Christi
- Kathy Ard Blanton, Nueces County
- Kathy Ard Blanton, Nueces County
- Luz Lumb, Chair
- Sally Farris, Co-Chair
- Jace Tunnell, Environmental, Coastal Bend Bays & Estuary Program

- Kori Ellien, City of Corpus Christi
- Bill Green, City of Corpus Christi
- Danielle Converse, City of Corpus Christi
- Bob Blair, Business & Industry
- Chris Tweedle
- Bob Blair, Business & Industry
- Valerie Gray, City of Corpus Christi
- Annette Rodriguez, Public Health
- Teresa Carrillo, Harte Research Institute Texas A&M University-Corpus Christi
- Tim Stephens, Business & Industry
- Erin Hill, Harte Research Institute Texas A&M University-Corpus Christi
- Lauren Dawson, TCEQ
- Ismael Nava, Coastal Bend Bays Foundation
- Wyatt Eason, TCEQ
- Daniel Ryne Lucio, Coastal Bend Bays Foundation
- Roger Miranda, TCEQ
- Debbie Grimaldi, Coastal Bend Bays Foundation
- Chris Loft, TCEQ
- Brien Nicolau, Center for Coastal Studies, Texas A&M University-Corpus Christi

***In Memory of Peggy Sumner, 1955-2013, First CARP Chair***

# Oso Coordination Committee Members and Stakeholder Group Representation

## Oso Stakeholders

- Steve Synovitz, Oso Chair Technical, Science, and Environmental
- Sharon Bailey Lewis, City of Corpus Christi
- Lionel Lopez, Colonias
- Tony Wood, Large Landowners
- Kathy Ard Blanton, Nueces County
- Kimberly McGlaunn, Transportation
- Scott Frazier, Agriculture
- John Rodriguez, City of Robstown

### Education and Outreach

- Bob Paulison, Industry, Coastal Economy
- Lois Huff, Nonprofit organizations, Advocacy
- Johnny Cotton, Recreation and Tourism
- Sara Jose, Wildlife

### Oso Coordination Committee Alternates

- Rae Mooney, Oso Co-Chair Technical, Science, and Environmental
- Daniel McGinn, City of Corpus Christi
- Sinoel Contreras, Colonias
- Gay Gilson, Homeowners
- Mark Stroop, Large Landowners
- Melissa Munguia, Nueces County
- Aaron Arroyo, Transportation
- Brian Koch, Agriculture
- Roy Gutierrez, City of Robstown
- Carolyn Moon, Nonprofit organizations, Advocacy
- Caleb Harris, Wildlife

### Past Oso Members

- Jay Reining, Homeowners
- Christopher Boyce, Nueces County
- Jason Ott, Education and Outreach
- Eugenia Jean Barnes, Education and Outreach

### Oso Support

- Lauren Dawson, TCEQ
- Erin Hill, Center for Coastal Studies, Texas A&M University-Corpus Christi
- Wyatt Eason, TCEQ
- Teresa Carrillo, Center for Coastal Studies, Texas A&M University-Corpus Christi
- Nicole Hall, TCEQ

### Past Oso Support

- Brien Nicolau, Center for Coastal Studies, Texas A&M University-Corpus Christi
- Lauren Young, TCEQ

# Appendix C. Resolutions/Letters of Support for the CARP I-Plan

The following are resolutions and letters of support from organizations and individuals within the local community committed to supporting the improvement of water quality through the actions of this I-Plan.

**Resolution by the City Council of the City of Corpus Christi supporting the Implementation Plan for Improved water quality, to reduce bacteria, developed by the Cole and Ropes Parks' Coordination Committee (CARP) for Cole and Ropes Park Beaches located in Corpus Christi Bay and the Louisiana Parkway Watershed (Watershed) in Corpus Christi, Texas.**

**WHEREAS**, the City of Corpus Christi is a coastal city valuing its shoreline for aesthetic, economic, recreation, and public health reasons; and

**WHEREAS**, in 2012 the City of Corpus Christi was invited to participate as a stakeholder in water quality restoration planning for Cole and Ropes Park Beaches: and

**WHEREAS,** the CARP Coordination Committee, a twelve-member stakeholder committee, was formed and elected at a public meeting held in 2012, representing thousands of basin stakeholders, including interests in business, tourism, recreation, environmental resources, public health and safety, academia, and home ownership, as well as three staff representatives from the City of Corpus Christi, and was facilitated by the Coastal Bend Bays Foundation and the Center for Coastal Studies, Texas A&M University – Corpus Christi, on behalf of the Texas Commission on Environmental Quality (TCEQ); and

**WHEREAS**, the aforesaid "Watershed" stakeholders and entities represented in the CARP Coordination Committee,along with the Texas Commission on Environmental Quality (TCEQ), and the U.S. Environmental Protection Agency (EPA) have worked together to plan and implement voluntary and mandatory actions appropriate to community needs to improve water quality through common sense strategies that reflect the natural environment, recreational uses, and economy or the region; and

**WHEREAS**, the TCEQ established two separate Total Maximum Daily Loads (TMDL) projects, for bacteria, otherwise known as pollution budgets, one each, for Cole and Ropes Park; and

**WHEREAS**, the TMDL is a scientifically determination of how much pollutant the water body can naturally assimilate each day and remain healthy; and

**WHEREAS,** the established TMDL projects will require implementation activities that will reduce existing pollutant loads from point sources and non-point sources that the TCEQ identified during development of the two TMDLs; and

**WHEREAS**, the CARP Coordination Committee and Work Group stakeholders spent thousands of volunteer hours in meetings preparing the Implementation Plan (I-Plan) that will recommend to TCEQ a variety of activities to remedy the high levels of bacteria in both Cole and Ropes Park beaches, as identified in the two TMDL projects, and seeks resolutions of support from its members, which I–Plan is attached as Exhibit A.

030984

**INDEXED**

**NOW, THEREFORE, BE IT HEREBY RESOLVED BY THE CITY OF CORPUS CHRISTI:**

**Section 1.**

That, the City supports the CARP I-Plan and pledges its participation to implement those activities identified in the I-Plan for which it has responsibility, using those funds that have been or may be appropriated for them.

**Section 2.** This Resolution shall take effect and be in full force immediately after its adoption by the City Council.

**ATTEST:**

Rebecca Huerta
Rebecca Huerta
City Secretary

**THE CITY OF CORPUS CHRISTI**

Nelda Martinez
Mayor

Corpus Christi, Texas
18th of October, 2016

The above resolution was passed by the following vote:

| | |
|---|---|
| Nelda Martinez | Aye |
| Rudy Garza | Aye |
| Michael Hunter | Aye |
| Chad Magill | Aye |
| Colleen McIntyre | Aye |
| Brian Rosas | Aye |
| Lucy Rubio | Aye |
| Mark Scott | absent |
| Carolyn Vaughn | Aye |

030984


**Surfrider Foundation**
**Texas Coastal Bend Chapter**
122 Whiteley Drive
Corpus Christi, TX 78418
(361) 937-2115
www.coastalbend.surfrider.org
email:surfridertxcbc@yahoo.com

## Letter of Support

Implementation Plan for One Total Maximum Daily Load for Bacteria at Cole and Ropes Beaches in Corpus Christi Bay (***I-Plan***)

**TO:** Texas Commission on Environmental Quality; the General Public; Civic and Governmental Organizations Interested in Bay Beaches Safety and Marine Surface Water Quality in the Corpus Christi Area

**FROM:** The **Texas Coastal Bend Chapter of the Surfrider Foundation**, the local chapter of an international organization with vision to keep our beaches open to everyone, promote smart coastal development that avoids coastal impacts, protect special ocean and coastal places, ensure the water is clean to surf and swim and the beaches are free of plastic litter.

**Background:** Beginning in April, 2012, the Texas Commission on Environmental Quality (TCEQ) sponsored a series of public meetings to address elevated levels of bacteria in specific parts of Corpus Christi Bay. The target areas were bay waters receiving storm water from outfalls at Cole and Ropes Parks. These problem segments include beach areas adjacent the parks. And, the segments had been designated by the US Environmental Protection Agency to join other polluted waters on the national 303(d) impaired waters list, bodies unfit for recreational use in violation of the federal Clean Water Act under applicable water quality standards.

In June 2012, attendees at the third public meeting elected stakeholder participants to collaborate in work groups over four years to devise a bacteria reduction plan to help bay water adjacent Cole and Ropes Parks comply with recreational standards. The stakeholder participants, who dubbed themselves CARP (Coles and Ropes Park Coordination Committee), entered into an action Guideline agreement that pledged their continued work and plan review into the future in additional five (5) year increments. The current plan was finalized in March, 2016.

**STATEMENT OF SUPPORT:** Primary goals of the Surfrider Foundation and its Texas Coastal Bend Chapter are the preservation of our shorelines, their water

quality and their access to all. For about ten years our chapter has conducted regular storm stenciling events within the City of Corpus Christi, including the Cole and Ropes Park watersheds, to remind our community that what is on our streets ends up in our Bay. The Texas Coastal Bend Chapter of the Surfrider Foundation strongly supports the proposed Bacteria Reduction Implementation Plan (I-Plan) and its voluntary approach for reducing bacteria levels in Corpus Christi Bay at Cole and Ropes Park. Our chapter and its volunteers will also continue to be ready to assist our community in improving our bay's and coastline water quality.

Respectfully,

Cliff M. Schlabach

Cliff Schlabach
Chair, Texas Coastal Bend Chapter of Surfrider

**Corpus Christi – Nueces County**
**Public Health District**
**Support Services Division-Administration**
1702 Horne Rd., Corpus Christi, TX 78416
Phone: 361-826-7205 Fax: 361-826-1343

Public Health
Prevent. Promote. Protect.

August 10, 2016

Mr. Chris Loft
Total Maximum Daily Load Program
Texas Commission on Environmental Quality
MC-203
P.O. Box 13087
Austin, TX 78711-3087

RE: Letter of Support for *Implementation Plan for Two Total Maximum Daily Loads for Bacteria at Cole and Ropes Parks Beaches in Corpus Christi Bay* (*I-Plan*)

Dear Mr. Loft,

Please accept this letter of support from William Burgin JR MD for the "*Implementation Plan for Two Total Maximum Daily Loads for Bacteria at Cole and Ropes Parks Beaches in Corpus Christi Bay (I-Plan).*" When water testing at the Cole and Ropes Parks beaches revealed that bacteria levels in the water exceeded water quality standards for recreational use, the beaches landed on EPA's 303(d) list for polluted waters. In July 2012 a community-led stakeholder group was formed, the Cole and Ropes Parks Bacteria Reduction Implementation Plan Coordination Committee (CARP), which has been meeting since then to create the final *I-Plan*.

We believe the *I-Plan* lays out reasonable and measurable steps to improve water quality at the Parks' beaches. We also believe that implementation of this common-sense, voluntary approach, would benefit residents and visitors alike to the city of Corpus Christi, by reducing bacteria in the water at Cole and Ropes Parks beaches. Cleaner, safer water at our City park beaches is both a highly desirable and achievable outcome of this *I-Plan*.

We look forward to the positive results this *I-Plan* will have for reducing bacteria at Cole and Ropes Parks beaches, thus ensuring the safety and health of our community members and visitors.

Respectfully,

William a Burgin MD

William Burgin JR MD
Name

LOCAL HEALTH AUTHORITY CC-NCPHD
Tittle

August 10, 2016
Date

WWB

**League of Women Voters - Corpus Christi Area**

P. O. Box 8276 • Corpus Christi, TX 78468
(361) 445-4436
htt://www.lwv-cc.org

**Letter of Support**
Bacteria Reduction Implementation Plan
For
Cole and Ropes Parks, Corpus Christi, Texas

**TO:** Texas Commission on Environmental Quality; the General Public; Civic and Governmental Organizations Interested in Bay Beaches Safety and Marine Surface Water Quality in the Corpus Christi Area [ADD OTHER ORGANIZATIONS OR SPECIFIC GOVERNMENTAL BODIES, SUCH AS THE COMMISSIONERS COURT OF NUECES COUNTY, TEXAS; AREA COGS, etc. that the SENDER may additionally identify.]

**FROM:** **The Corpus Christi League of Women Voters**, a nonpartisan, political Organization, that encourages informed and active participation in government, Works *to increase understanding of major public policy issues*, and influences Public policy through education and advocacy. The League does not support or oppose any political party or candidate.

**Background:** Beginning in April, 2012, the Texas Commission on Environmental Quality (TCEQ) sponsored a series of public meetings to address elevated levels of bacteria in specific parts of Corpus Christi Bay. The target areas were bay waters receiving storm water from outfalls at Cole and Ropes Parks. These problem segments include beach areas adjacent the parks. And, the segments had been designated by the US Environmental Protection Agency to join other polluted waters on the national 303(d) impaired waters list, bodies unfit for recreational use in violation of the federal Clean Water Act under applicable water quality standards.

In June 2012, attendees at the third public meeting elected stakeholder participants to collaborate in work groups over four years to devise a bacteria reduction plan to help bay water adjacent Cole and Ropes Parks comply with recreational standards. The stakeholder participants, who dubbed themselves CARP, entered into an action Guideline agreement that pledged their continued work and plan review into the future in additional five (5) year increments. The current plan was finalized in March, 2016.

**STATEMENT OF SUPPORT:** We, the League of Women Voters of Corpus Christi, Texas, support the Bacteria Reduction Implementation Plan for Cole and Ropes Parks. Improved recreational water quality in the target segments of Cole and Ropes Parks is consistent with the League of Women Voters' Policy Positions for Natural Resources, developed over the years, reviewed and affirmed by members at the May 2016 Annual Meeting.

By: _____
Dr. Mary Jane Garza, President

Date: July 28, 2016

United Corpus Christi
CHAMBER of COMMERCE

August 30, 2016

Mr. Chris Loft
Total Maximum Daily Load Program
Texas Commission on Environmental Quality
MC-203
P.O. Box 13087
Austin, TX 78711-3087

RE: Letter of Support for *Implementation Plan for Two Total Maximum Daily Loads for Bacteria at Cole and Ropes Parks Beaches in Corpus Christi Bay* (*I-Plan*)

Dear Mr. Loft,

On behalf of the United Corpus christi Chamber of Commerce's 1100 members, please accept this letter of support for the "*Implementation Plan for Two Total Maximum Daily Loads for Bacteria at Cole and Ropes Parks Beaches in Corpus Christi Bay (I-Plan).*" When water testing at the Cole and Ropes Parks beaches revealed that bacteria levels in the water exceeded water quality standards for recreational use, the beaches landed on EPA's 303(d) list for polluted waters. In July 2012 a community-led stakeholder group was formed, the Cole and Ropes Parks Bacteria Reduction Implementation Plan Coordination Committee (CARP), which has been meeting since then to create the final *I-Plan*.

We believe the *I-Plan* lays out reasonable and measurable steps to improve water quality at the Parks' beaches. We also believe that implementation of this common-sense, voluntary approach, would benefit residents and visitors alike to the city of Corpus Christi, by reducing bacteria in the water at Cole and Ropes Parks beaches. Cleaner, safer water at our City park beaches is both a highly desirable and achievable outcome of this *I-Plan*.

We look forward to the positive results this *I-Plan* will have for reducing bacteria at Cole and Ropes Parks beaches, thus ensuring the safety and health of our community members and visitors.

Respectfully,

Annette Medlin

Annette Medlin, IOM

President and CEO

1501 N. Chaparral Corpus Christi, Texas 78401 361.881.1800 www.unitedcorpuschristichamber.com

**Memorandum Letter of Support**

Bacteria Reduction Implementation Plan
For
Cole and Ropes Parks, Corpus Christi, Texas

**TO:** Texas Commission on Environmental Quality; the General Public; Civic and Governmental Organizations Interested in Bay Beaches Safety and Marine Surface Water Quality in the Corpus Christi Area.

**The Clean Economy Coalition (CEC),** a nonprofit environmental organization committed to improving the human and environmental health of the Coastal Bend, has reviewed the Implementation Plan (I-Plan) created by the Cole And Ropes Park (CARP) Committee to determine methods of reducing bacteria levels in Corpus Christi Bay for the betterment of our community.

**Background:** Beginning in April, 2012, the Texas Commission on Environmental Quality (TCEQ) sponsored a series of public meetings to address elevated levels of bacteria in specific parts of Corpus Christi Bay. The target areas were bay waters receiving storm water from outfalls at Cole and Ropes Parks. These problem segments include beach areas adjacent to the parks, which had been designated by the US Environmental Protection Agency to join other polluted waters on the national 303(d) impaired waters list, bodies unfit for recreational use in violation of the federal Clean Water Act under applicable water quality standards.

In June 2012, attendees at the third public meeting elected stakeholder participants to collaborate in work groups over four years to devise a bacteria reduction plan to help bay water adjacent Cole And Ropes Parks comply with recreational standards. The stakeholder participants, who dubbed themselves CARP, entered into an action guideline agreement that pledged their continued work and plan review into the future in additional five (5) year increments. The CARP Committee expects to bring the I-Plan current plan was finalized in March, 2016.

**STATEMENT OF SUPPORT:** We, the members of Clean Economy Coalition of Corpus Christi endorse the Bacteria Reduction Implementation Plan for Cole and Ropes Parks. Improved recreational water quality in the target segments of Cole and Ropes Parks is consistent with the CEC's policy positions. The CEC applauds the extensive effort that has gone into creation of this document and urges the CARP Committee to continue efforts to implement elements of the I-plan with the goal of reducing bacteria levels in Corpus Christi Bay to consistently safe levels for human contact.

**BY:** James E. Klein Date: 10-3-2016

Dr. James E. Klein
Chair, Clean Economy Coalition

## Letter of Support

Implementation Plan for One Total Maximum Daily Load for Bacteria
at Cole and Ropes Beaches in Corpus Christi Bay (***I-Plan***)

**TO:** Texas Commission on Environmental Quality; the General Public; Civic and Governmental Organizations Interested in Bay Beaches Safety and Marine Surface Water Quality in the Corpus Christi Area

**FROM: Coastal Bend Windsurfers**, a group of windsurfers (list attached) who have regularly enjoyed practicing their sport at Cole and Ropes Park, some for over 25 years.

**Background:** Beginning in April, 2012, the Texas Commission on Environmental Quality (TCEQ) sponsored a series of public meetings to address elevated levels of bacteria in specific parts of Corpus Christi Bay. The target areas were bay waters receiving storm water from outfalls at Cole and Ropes Parks. These problem segments include beach areas adjacent the parks. And, the segments had been designated by the US Environmental Protection Agency to join other polluted waters on the national 303(d) impaired waters list, bodies unfit for recreational use in violation of the federal Clean Water Act under applicable water quality standards.

In June 2012, attendees at the third public meeting elected stakeholder participants to collaborate in work groups over four years to devise a bacteria reduction plan to help bay water adjacent Cole and Ropes Parks comply with recreational standards. The stakeholder participants, who dubbed themselves CARP (Coles and Ropes Park Coordination Committee), entered into an action Guideline agreement that pledged their continued work and plan review into the future in additional five (5) year increments. The current plan was finalized in March, 2016.

**STATEMENT OF SUPPORT:** Coles and Ropes Parks are some of our nation's premier windsurfing locations. Several regional and international competitions were held at Cole Park since the early eighties including the 2016 US Windsurfing Nationals organized by the US Windsurfing Association. The nearshore water quality of these parks is an obvious concern to this group and to other recreational users. For example windsurfers typically abstain from launching from these parks after rain events. Coastal Bend windsurfers wholeheartedly support the proposed Bacteria Reduction Implementation Plan (I-Plan) and its voluntary approach for reducing bacteria levels in Corpus Christi Bay at Cole and Ropes Park. Improved recreational water quality will reduce the risk of negative health impact from practicing our sport. These benefits will extend to other recreational users who enjoy these wonderful parks. Better water quality in our parks is also important for our city as our waterfront is a wonderful resource well known regionally and, in the case of Oleander Point at Cole Park, known internationally in the windsurfing community.

By: Coastal Bend Windsurfers (see attached signatures)

Below Coastal Bend Windsurfers signatures expressing their support for the Bacteria Reduction Implementation Plan for Cole and Ropes Parks.

| Name, First Name | Signature | Residence (Street & City if not Corpus Christi) |
|---|---|---|
| Laurence Pereiro | | 1504 6th St |
| Chip Ducrest | | 314 Meldo Park Dr. |
| Florence Tissot | | 3560 Aransas St. |
| Monika Caldwell | | 1008 FURMAN AVE. |
| BRENDT MAIN | | 3938 SURFSIDE BLVD |
| TERRY CALDWELL | | 1009 FURMAN AVE |
| TARA DUCREST | | 314 Meldo Park Dr. |
| Philippe Tissot | | 3560 Aransas St. |
| ROBERT CONACE | | 15357 CARAVEL 78418 |
| Randy Rhodes | | 16114 Coral Vine Dr |
| Lanny Schneider | | 408 Brimstone, Rockport TX 78382 |
| TERESINHA CANDRY | | |
| DONALD JACKSON | | 13517 QUEEN ANNAS CC 78418 |
| OLIVIER JALLAIS | | 7158 WINDBROOK CC 78414 |
| Robert M'Gonigle | | 339 Poenisch |
| Chad Allen | | 302 Wiltshire |
| PATRICK FOLEY | | 15854 El Soccorro |
| ANN FOLEY | | " " " |

Below Coastal Bend Windsurfers signatures expressing their support for the Bacteria Reduction Implementation Plan for Cole and Ropes Parks.

| Name, First Name | Signature | Residence (Street & City if not Corpus Christi) |
|---|---|---|
| Charles Allen | Charles Allen | 5626 Muriel CC TX 784 |
| Cole Tschritter | | 16813 El Soccorro Loop TX 784 |
| CHRIS DAVIS | | 5007 W Francis 21 Austin TX 78 |
| VANESA WILBURN | | 11 |
| SPECK, Gary | | 2059 Parkview Ingleside, TX 78362 |
| CALDWELL, TERRY | | 1008 FURMAN AVENUE CrC - TX, 78404 |
| Ellen Blumenthal | | 13517 Queen Johanna CC TX 78418 |
| Alissa Mejia | | 4302 Ocean Dr # 68 Corpus Christi, TX 78412 |
| Deidre Williams | | 322 Canterbury Dr CC TX 78412 |
| Jon Brandt | | 15340 Leeward Dr., Unit 314 Corpus Christi, TX 78418 |
| Anthony Reisinger | | 3016 Topeka CC TX 78404 |
| Kyle Krebs | | 609 McClendon CC TX 78404 |

**Coastal Bend Bays & Estuaries Program, Inc.**
615 N. Upper Broadway, Suite 1200, Corpus Christi, TX 78401-0749 • 361-336-0304 • 361-400-5362 (fax)

July 28, 2016

Mr. Chris Loft
Total Maximum Daily Load Program
Texas Commission on Environmental Quality
MC-203
P.O. Box 13087
Austin, TX 78711-3087

RE: Letter of Support for *Implementation Plan for Two Total Maximum Daily Loads for Bacteria at Cole and Ropes Parks Beaches in Corpus Christi Bay* (*I-Plan*)

Dear Mr. Loft,

On behalf of the Coastal Bend Bays & Estuaries Program, I am writing to offer my support for the "*Implementation Plan for Two Total Maximum Daily Loads for Bacteria at Cole and Ropes Parks Beaches in Corpus Christi Bay (I-Plan).*" When water testing at the Cole and Ropes Parks beaches revealed that bacteria levels in the water exceeded water quality standards for recreational use, the beaches landed on EPA's 303(d) list for polluted waters. In July 2012 a community-led stakeholder group was formed, the Cole and Ropes Parks Bacteria Reduction Implementation Plan Coordination Committee (CARP), which has been meeting since then to create the final *I-Plan*.

We believe the *I-Plan* lays out reasonable and measurable steps to improve water quality at the Parks' beaches. We also believe that implementation of this common-sense, voluntary approach, would benefit residents and visitors alike to the city of Corpus Christi, by reducing bacteria in the water at Cole and Ropes Parks beaches. Cleaner, safer water at our City park beaches is both a highly desirable and achievable outcome of this *I-Plan*.

The efforts within Cole and Ropes Parks are an important step towards reducing bacteria in the water at Cole and Ropes Parks beaches, and supports the Coastal Bend Bays & Estuaries Program Coastal Bend Bays Plan, specifically our Water and Sediment Quality Action Plan, Habitat and Living Resources Action Plan, and our Human Uses Action Plan. We have been and will continue to work with the CARP to provide our technical and scientific expertise as needed, and we look forward to the positive results this *I-Plan* will have for reducing bacteria at Cole and Ropes Parks beaches.

Sincerely,
*Ray Allen*
Ray Allen
Executive Director
Coastal Bend Bays & Estuaries Program
www.cbbep.org

*Visit our website – www.cbbep.org*

July 15, 2016

Mr. Chris Loft
Total Maximum Daily Load Program
Texas Commission on Environmental Quality
MC-203
P.O. Box 13087
Austin, TX 78711-3087

**PARKS & RECREATION DEPARTMENT**

PO Box 9277
Corpus Christi
Texas 78469-9277
Phone 361-826-3460
Fax 361-880-3864
www.cctexas.com
www.ccparkandrec.com

*Live. Learn. Play!*

RE: Letter of Support for *Implementation Plan for Two Total Maximum Daily Loads for Bacteria at Cole and Ropes Parks Beaches in Corpus Christi Bay* (*I-Plan*)

Dear Mr. Loft,

Please accept this letter of support from the Parks and Recreation Advisory Committee of the City of Corpus Christi for the "*Implementation Plan for Two Total Maximum Daily Loads for Bacteria at Cole and Ropes Parks Beaches in Corpus Christi Bay (I-Plan).*" The Parks and Recreation Advisory Committee held their monthly meeting on Wednesday, July 13, 2016 and voted unanimously to support the *I-Plan*. When water testing at the Cole and Ropes Parks beaches revealed that bacteria levels in the water exceeded water quality standards for recreational use, the beaches landed on EPA's 303(d) list for polluted waters. In July 2012, a community-led stakeholder group was formed, the Cole and Ropes Parks Bacteria Reduction Implementation Plan Coordination Committee [CARP], which has been meeting since then to create the *I-Plan*.

We believe the *I-Plan* lays out reasonable and measurable steps to improve water quality at the Parks' beaches. We also believe that implementation of this common-sense, voluntary approach, would benefit residents and visitors alike to the city of Corpus Christi, by reducing bacteria in the water at Cole and Ropes Parks beaches. Cleaner, safer water at our City park beaches is both a highly desirable and achievable outcome of this *I-Plan*.

We look forward to the positive results this *I-Plan* will have for reducing bacteria at Cole and Ropes Parks beaches, thus ensuring the safety and health of our community members and visitors.

Respectfully,

Stacie Talbert Anaya
Parks & Recreation Interim Director

7/15/16
Date

CORPUS CHRISTI PARKS& RECREATION

COASTAL BEND BAYS FOUNDATION

Board of Directors
President
Jace Tunnell
Exec. Vice President
Danielle Converse
Vice President, Environment
Paul Silva
Vice President, Industry
Danna Hill Sharpe
Vice President, Government
Sharon Bailey Lewis
Treasurer
R. Jay Reining
Secretary
Colleen Johnson
Delegate to CBBEP
Robert B. Wallace, Jr.
Delegate to NEAC
Teresa A. Carrillo
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Jonas Chupe
Dave Sullivan
Lauren Hutchison
Dick Bowers (Emeritus)
Bernard A. Paulson (Dir. Emeritus)
Pat Suter (Emeritus)
Robert B. Wallace, Jr. (Emeritus)

EXECUTIVE DIRECTOR

1227 Agnes, Ste. B-1
Corpus Christi, Texas 78401
P. (361) 882-3439
F. (361) 882-5625
E. cbbf@baysfoundation.org

A Partnership for Conservation
www.baysfoundation.org

July 29, 2016

Mr. Chris Loft
Total Maximum Daily Load Program
Texas Commission on Environmental Quality
MC-203
P.O. Box 13087
Austin, TX 78711-3087

RE: Letter of Support for *Implementation Plan for Two Total Maximum Daily Loads for Bacteria at Cole and Ropes Parks Beaches in Corpus Christi Bay* (*I-Plan*)

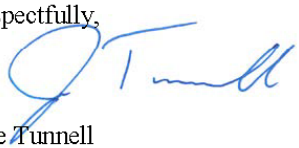
Dear Mr. Loft,

Please accept this letter of support from the Coastal Bend Bays Foundation for the "*Implementation Plan for Two Total Maximum Daily Loads for Bacteria at Cole and Ropes Parks Beaches in Corpus Christi Bay (I-Plan).*" When water testing at the Cole and Ropes Parks beaches revealed that bacteria levels in the water exceeded water quality standards for recreational use, the beaches landed on EPA's 303(d) list for polluted waters. In July 2012 a community-led stakeholder group was formed, the Cole and Ropes Parks Bacteria Reduction Implementation Plan Coordination Committee (CARP), which has been meeting since then to create the final *I-Plan*.

We believe the *I-Plan* lays out reasonable and measurable steps to improve water quality at the Parks' beaches. We also believe that implementation of this common-sense, voluntary approach, would benefit residents and visitors alike to the city of Corpus Christi, by reducing bacteria in the water at Cole and Ropes Parks beaches. Cleaner, safer water at our City park beaches is both a highly desirable and achievable outcome of this *I-Plan*.

We look forward to the positive results this *I-Plan* will have for reducing bacteria at Cole and Ropes Parks beaches, thus ensuring the safety and health of our community members and visitors.

Respectfully,



Jace Tunnell
President

**Letter of Support**
Bacteria Reduction Implementation Plan
For
Cole and Ropes Parks, Corpus Christi, Texas

**TO:** Texas Commission on Environmental Quality; the General Public; Civic and Governmental Organizations Interested in Bay Beaches Safety and Marine Surface Water Quality in the Corpus Christi Area.

**FROM:** **The Corpus Christi Taxpayers Association**, a watchdog society active since the 1920s, organized to keep taxes, fees, and utility bills at reasonable rates that all taxpayers in the City of Corpus Christi and Nueces County can afford. Our association is an effective voice of citizens, carrying a message to elected officials that the community expects wise, not wasteful, use of tax dollars.

**Background:** Beginning in April, 2012, the Texas Commission on Environmental Quality (TCEQ) sponsored a series of public meetings to address elevated levels of bacteria in specific parts of Corpus Christi Bay. The target areas were bay waters receiving storm water from outfalls at Cole and Ropes Parks. These problem segments include beach areas adjacent the parks. And, the segments had been designated by the US Environmental Protection Agency to join other polluted waters on the national 303(d) impaired waters list, bodies unfit for recreational use in violation of the federal Clean Water Act under applicable water quality standards.

In June 2012, attendees at the third public meeting elected stakeholder participants to collaborate in work groups over four years to devise a bacteria reduction plan to help bay water adjacent Cole and Ropes Parks comply with recreational standards. The stakeholder participants, who dubbed themselves CARP, entered into an action Guideline agreement that pledged their continued work and plan review into the future in additional five (5) year increments. The current plan was finalized in March, 2016.

**STATEMENT OF SUPPORT:** The Corpus Christi Taxpayers Association supports the Bacteria Reduction Implementation Plan for Cole and Ropes Parks. Improved recreational water quality in the target segments of Cole and Ropes Parks is consistent with our policy to support projects that benefit a majority of individuals and communities in the area affected at reasonable costs.

By: Gerald A. Sansing Date: August 6, 2016
Dr. Gerald Sansing, President
Corpus Christi Taxpayers Association

**Letter of Support**
Bacteria Reduction Implementation Plan
For
Cole and Ropes Parks, Corpus Christi, Texas

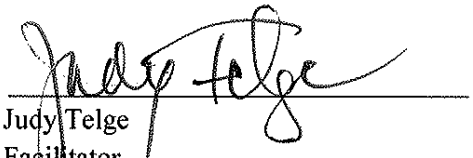
**TO:** Texas Commission on Environmental Quality; the General Public; Civic and Governmental Organizations Interested in Bay Beaches Safety and Marine Surface Water Quality in the Corpus Christi Area, City of Corpus Christi, Nueces County, Coastal Bend Council of Governments.

**FROM:** Bay Area Smart Growth Initiative.

**Background:** Beginning in April, 2012, the Texas Commission on Environmental Quality (TCEQ) sponsored a series of public meetings to address elevated levels of bacteria in specific parts of Corpus Christi Bay. The target areas were bay waters receiving storm water from outfalls at Cole and Ropes Parks. These problem segments include beach areas adjacent the parks. And, the segments had been designated by the US Environmental Protection Agency to join other polluted waters on the national 303(d) impaired waters list, bodies unfit for recreational use in violation of the federal Clean Water Act under applicable water quality standards.

In June 2012, attendees at the third public meeting elected stakeholder participants to collaborate in work groups over four years to devise a bacteria reduction plan to help bay water adjacent Cole and Ropes Parks comply with recreational standards. The stakeholder participants, who dubbed themselves CARP, entered into an action Guideline agreement that pledged their continued work and plan review into the future in additional five (5) year increments. The current plan was finalized in March, 2016.

**STATEMENT OF SUPPORT: Bay Area Smart Growth Initiative** (BASGI) supports the Bacteria Reduction Implementation Plan for Cole and Ropes Parks. Improved recreational water quality in the target segments of Cole and Ropes Parks is consistent with Smart Growth principles supporting benefits to the general public and preserving critical environmental areas.

By: 

Judy Telge
Facilitator
**Bay Area Smart Growth Initiative**

Date: August 6, 2016

Sierra Club Coastal Bend Group
PO Box 3512
Corpus Christi, TX 78463

August 8, 2016

Mr. Chris Loft
Total Maximum Daily Load Program
Texas Commission on Environmental Quality
MC-203
P.O. Box 13087
Austin, TX 78711-3087

RE: Letter of Support for *Implementation Plan for Two Total Maximum Daily Loads for Bacteria at Cole and Ropes Parks Beaches in Corpus Christi Bay* (*I-Plan*)

Dear Mr. Loft,

Please accept this letter of support from the ***Sierra Club Coastal Bend Group*** for the "*Implementation Plan for Two Total Maximum Daily Loads for Bacteria at Cole and Ropes Parks Beaches in Corpus Christi Bay (I-Plan).*" When water testing at the Cole and Ropes Parks beaches revealed that bacteria levels in the water exceeded water quality standards for recreational use, the beaches landed on EPA's 303(d) list for polluted waters. In July 2012 a community-led stakeholder group was formed, the Cole and Ropes Parks Bacteria Reduction Implementation Plan Coordination Committee (CARP), which has been meeting since then to create the final *I-Plan*.

We believe the *I-Plan* lays out reasonable and measurable steps to improve water quality at the Parks' beaches. We also believe that implementation of this common-sense, voluntary approach, would benefit residents and visitors alike to the city of Corpus Christi, by reducing bacteria in the water at Cole and Ropes Parks beaches. Cleaner, safer water at our City park beaches is both a highly desirable and achievable outcome of this *I-Plan*.

We look forward to the positive results this *I-Plan* will have for reducing bacteria at Cole and Ropes Parks beaches, thus ensuring the safety and health of our community members and visitors.

Respectfully,

*Lois Huff*

Lois Huff, Chair
Sierra Club Coastal Bend Group

CORPUS CHRISTI
CONVENTION & VISITORS BUREAU

August 8, 2016

Mr. Chris Loft
Total Maximum Daily Load Program
Texas Commission on Environmental Quality
MC-203
P.O. Box 13087
Austin, TX 78711-3087

RE: Letter of Support for *Implementation Plan for Two Total Maximum Daily Loads for Bacteria at Cole and Ropes Parks Beaches in Corpus Christi Bay* (*I-Plan*)

Dear Mr. Loft,

Please accept this letter of support from Corpus Christi Convention & Visitors Bureau for the "*Implementation Plan for Two Total Maximum Daily Loads for Bacteria at Cole and Ropes Parks Beaches in Corpus Christi Bay (I-Plan).*" When water testing at the Cole and Ropes Parks beaches revealed that bacteria levels in the water exceeded water quality standards for recreational use, the beaches landed on EPA's 303(d) list for polluted waters. In July 2012 a community-led stakeholder group was formed, the Cole and Ropes Parks Bacteria Reduction Implementation Plan Coordination Committee (CARP), which has been meeting since then to create the final *I-Plan*.

We believe the *I-Plan* lays out reasonable and measurable steps to improve water quality at the Parks' beaches. We also believe that implementation of this common-sense, voluntary approach, would benefit residents and visitors alike to the city of Corpus Christi, by reducing bacteria in the water at Cole and Ropes Parks beaches. Cleaner, safer water at our City park beaches is both a highly desirable and achievable outcome of this *I-Plan*.

We look forward to the positive results this *I-Plan* will have for reducing bacteria at Cole and Ropes Parks beaches, thus ensuring the safety and health of our community members and visitors.

Respectfully,

Paulette Kluge
CEO

101 N. Shoreline Boulevard | Suite 430 | Corpus Christi, TX 78401 | 361.881.1888 | VisitCorpusChristiTX.org

# Response to Public Comment:

# Implementation Plan for Seven Total Maximum Daily Loads for Indicator Bacteria in the Corpus Christi Region

| Tracking Number | Date Received | Affiliation of Commenter | Summary of Request or Comment | Summary of TCEQ Action, or Explanation |
|---|---|---|---|---|
| 001 | 3/4/2025 | Teresa Carrillo, stakeholder and former Contractor with Texas A&M - Corpus Christi | The commenter thanked two stakeholders who attended the meeting (Philippe Tissot and Jim Klein) and expressed appreciation for their involvement with the development of the I-Plan. She mentioned this I-Plan took a long time to finalize but that many stakeholder groups had been working on implementation already. The commenter also thanks the TMDL Program staff for their work to finalize the I-Plan. | TMDL staff appreciate Teresa Carrillo's involvement with this project. Her dedication to the watershed and its stakeholders has made a great impact on the I-Plan.<br><br>No changes were made to the I-Plan document based on this comment. |
| 002 | 3/4/2025 | Linda Lindsey, Parks and Recreation Advisory Committee | The commenter explained differences in the parks mentioned in the I-Plan, as well as Poenisch Park, The commenter explained that even though the parks are used for different recreational purposes, implementation strategies like pet waste signage would be beneficial at all parks in the I-Plan. | TCEQ appreciates the support of the Parks and Recreation Advisory Committee.<br><br>No changes were made to the I-Plan document based on this comment. |

# TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

**A RESOLUTION** approving the final *Implementation Plan for Seven Total Maximum Daily Loads for Indicator Bacteria in the Corpus Christi Region* (Assessment Units 2481CB_03, 2481CB_04, 2485A_01, 2485_01, 2485_02, 2485_03 and 2486_01) of the Bays and Estuaries Basin in Nueces County.
**TCEQ Docket No. 2024-1594-TML**
**TCEQ Project No. 2025-004-TML-NR**

WHEREAS, the Executive Director developed one Total Maximum Daily Load (TMDL) for indicator bacteria in Oso Bay (AUs 2485_01, 2485_02, 2485_03, and 2486_01) and presented it for consideration by the Texas Commission on Environmental Quality (Commission) during the Commission's public meeting on May 9, 2007;

WHEREAS, the Commission found that the TMDL for indicator bacteria in Oso Bay complied with all applicable state and federal laws and regulations; and accordingly, the commission adopted on August 22, 2007, the TMDL for indicator bacteria in Oso Bay and submitted it to the United States Environmental Protection Agency (EPA) for approval, where it was approved on June 6, 2008;

WHEREAS, the Executive Director developed one TMDL for indicator bacteria in Oso Creek (AU 2485A_01) and presented it for consideration by the Commission during the Commission's public meeting on January 30, 2019;

WHEREAS, the Commission found that the TMDL for indicator bacteria in Oso Creek complied with all applicable state and federal laws and regulations; and accordingly, the Commission adopted on July 31, 2019, the TMDL for indicator bacteria in Oso Creek and submitted it to EPA for approval, where it was approved on October 25, 2019;

WHEREAS, the Executive Director developed two TMDLs for indicator bacteria at Corpus Christi Bay Beaches, Cole Park and Ropes Park (AUs 2481CB_03 and 2481CB_04) and presented them for consideration by the Commission during the Commission's public meeting on August 12, 2020;

WHEREAS, the Commission found that the TMDLs for indicator bacteria at Corpus Christi Bay Beaches, Cole Park and Ropes Park complied with all applicable state and federal laws and regulations; and accordingly, the Commission adopted on July 28, 2021, the TMDLs for indicator bacteria at Corpus Christi Bay Beaches, Cole Park and Ropes Park and submitted them to EPA for approval, where they were approved on January 31, 2022;

WHEREAS, in order to comply with the "Implementation and Reasonable Assurance" section of the TMDLs, the Executive Director developed an Implementation Plan for the adopted TMDLs for indicator bacteria in Oso Bay, Oso Creek, and at Corpus Christi Bay Beaches, Cole Park and Ropes Park, and presented it for the Commission's consideration during its January 30, 2025 public meeting, at which the commission approved the Implementation Plan to be released for public comment;

NOW, THEREFORE, it is resolved by the Commission that the Implementation Plan for seven TMDLs for indicator bacteria in the Corpus Christi Region is APPROVED.

TEXAS COMMISSION ON
ENVIRONMENTAL QUALITY

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Brooke Paup, Chairwoman

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Date Signed