Nonpoint Source Management in Texas

2016
ANNUAL
REPORT

Texas Commission on Environmental Quality

Texas State Soil & Water Conservation Board

Funding provided by the Environmental Protection Agency through Clean Water Act Section 319(h) grant funds

SFR-066/16
January 2017

Cover & lead photos: Texas Hill Country
(Source:Thinkstock)

Authorization to use or reproduce any original material contained in this publication, not obtained from other sources, is freely granted. The Texas Commission on Environmental Quality (TCEQ) and the Texas State Soil and Water Conservation Board (TSSWCB) would appreciate acknowledgement.

Copies of this publication are available for public use through the Texas State Library, other state depository libraries, and the TCEQ Library, in compliance with state depository law. For more information on TCEQ publications visit our website at: **tceq.texas.gov/publications**

This document may also be downloaded from the TSSWCB website at: **www.tsswcb.texas.gov/reports**

Published and distributed by the

Texas Commission on Environmental Quality
P.O. Box 13087, Austin, TX 78711-3087

Texas State Soil and Water Conservation Board
P.O. Box 658, Temple, TX 76503

Nonpoint Source Management in Texas

2016
ANNUAL
REPORT

LETTER FROM THE EXECUTIVE DIRECTORS

The *Nonpoint Source Management Program* outlines Texas' comprehensive strategy to protect and restore waters across the state impacted by nonpoint source pollution. This strategy is implemented by utilizing voluntary, regulatory, financial, and technical assistance approaches, while working with a multitude of partners, to achieve a balanced program. The United States Environmental Protection Agency (EPA) provides grant funding to Texas to implement the components and goals set forth in the *Texas Nonpoint Source Management Program*. The responsibility for implementing this program is divided between the Texas Commission on Environmental Quality (TCEQ) and the Texas State Soil and Water Conservation Board (TSSWCB).

Texas has consistently worked with partners across the state to develop and implement watershed-based plans to improve water quality. At the close of fiscal year 2016, 17 watershed protection plans had been accepted by EPA, and more than 20 others are under development across the state. Together with partners and stakeholders the TCEQ and the TSSWCB are actively engaged in implementing voluntary management measures identified in the watershed-based plans.

The *Nonpoint Source Management Program* has continued to achieve success over the past year, including recognition by the EPA for restoration efforts and the approval of two "Success Stories." A success story is an EPA featured story about nonpoint source impaired water bodies where efforts have led to documented water quality improvements. The Watershed Action Planning process also continues to be integral to the development and implementation of watershed-based plans in Texas by coordinating, documenting, and tracking strategies and activities to protect and improve water quality.

We are pleased to present the *2016 Annual Report* of the state's *Nonpoint Source Management Program*. The report highlights our accomplishments in managing nonpoint source pollution and meeting the goals of the program. In partnership with the EPA and other federal, state, regional, and local watershed stakeholders, the TCEQ and the TSSWCB look forward to the continued implementation of an efficient, accountable, and transparent program.

Sincerely,

Rex Isom
Executive Director
Texas State Soil and Water Conservation Board

Richard A. Hyde, P.E.
Executive Director
Texas Commission on Environmental Quality

Santa Elena Canyon, Big Bend National Park *(Source:Thinkstock)*

CONTENTS

LETTER

Letter from the Executive Directors 4

1 CHAPTER

Introduction 9
- Defining Nonpoint Source Pollution 9
- What Guides Nonpoint Source Pollution Management in Texas? 9
  - Partnerships 9
  - The Texas Nonpoint Source Management Program 10
    - Goals for Nonpoint Source Management 10
      - Long-Term Goal 10
      - Short-Term Goals 10
  - The Watershed Approach 10
  - Watershed Action Planning 11

2 CHAPTER

Progress in Improving Water Quality 13
- Reductions in Pollutant Loadings 13
  - Geronimo Creek Septic System Decommissioning 13
  - Arroyo Colorado Agriculture Implementation 14
  - Lower Colorado River Authority's Creekside Conservation Program 14
- Water Quality Improvements 15
  - Success Story Highlights 15
    - Best Management Practices to Address Bacteria, Infrastructure Improvements, and Watershed Outreach to Improve Water Quality in the Guadalupe River Above Canyon Lake 15
      - Best Management Practices Implemented 15
      - Water Quality Improvements 16
    - Implementing Conservation Practices, Repairing Failing Septic Systems and Conducting Watershed Outreach Improves Water Quality in the Leon River and South Leon River 16
      - Best Management Practices Implemented 17
      - Water Quality Improvements 17

CONTENTS

3
CHAPTER

Progress Toward Meeting the Goals and Objectives of the Texas Nonpoint Source Management Program 19
Clean Water Act Section 319(h) Grant Program **19**
Status of Clean Water Act Section 319(h) Grant-Funded Projects **19**
Short-Term Goals and Milestones of the Texas Nonpoint Source Management Program **20**
Goal One—Data Collection and Assessment **20**
Texas Integrated Report **21**
Water Quality Status Categories **21**
Summary of the 2014 Integrated Report **23**
Summary of Impairments on the 2014 Integrated Report **23**
Continuous Water Quality Monitoring **23**
Texas Stream Team Monitoring **24**
Goal Two—Implementing Programs to Reduce Nonpoint Source Pollution **24**
Implementation Project Highlights **24**
Upper Cibolo Creek **24**
Lower Nueces River **26**
Total Maximum Daily Loads and Implementation Plans **26**
Texas Coastal Management Program **28**
Operating Septic Systems **28**
Urban Runoff **28**
Roads, Highways, and Bridges for Non-TxDOT Facilities **28**
Estuary Programs in Texas **28**
Galveston Bay Estuary Program **28**
Coastal Bend Bays and Estuaries Program **29**
Texas Groundwater Protection Committee **29**
Clean Water State Revolving Fund Loans for Nonpoint Source Projects **30**
Goal Three—Education **30**
Texas Well Owner Network **30**
Geronimo and Alligator Creeks Watershed Protection Plan Implementation and the Seguin Outdoor Learning Center **31**
Texas Watershed Stewards **31**
Statewide Riparian and Stream Ecosystem Education Program **32**
Texas A&M Forest Service **33**
Low Impact Development Education in the Lower Rio Grande Valley **33**

CONTENTS

4 CHAPTER

Developing and Implementing Watershed Protection Plans **35**

Watershed Protection Plan Highlights **38**

Mill Creek **38**

Education and Outreach Activities **38**

Watershed Implementation Activities **38**

Bastrop Bayou **38**

Watershed Implementation Activities **39**

ABBREVIATIONS & APPENDIX

Abbreviations **40**

Appendix **41**

Texas Nonpoint Source Management Program Milestones **41**

LIST OF FIGURES & TABLES

Figures

Figure 1.1 Social, Economic, and Environmental Considerations for Water Quality Restoration **10**

Figure 2.1 Map of BMP Locations in the Guadalupe River Above Canyon Lake Watershed **16**

Figure 2.2 The Leon River Watershed with De-Listed AUs Highlighted **17**

Figure 3.1 TCEQ Fiscal Year 2016 Nonpoint Source Grant Funds **20**

Figure 3.2 TSSWCB Fiscal Year 2016 Nonpoint Source Grant Funds **20**

Figure 3.3 Continuous Water Quality Monitoring Stations **23**

Figure 4.1 Map of Watersheds with Watershed Protection Plans (WPP), Watershed Characterization (WC), or TMDL Implementation Plans Being Developed or Implemented **36**

Tables

Table 3.1 Number of Water Bodies Assigned to Each Assessment Category in the 2014 Integrated Report **21**

Table 3.2 Number of Impairments in the 2014 Integrated Report **22**

Table 3.3 Summary of Impairments in the 2012 Versus 2014 Integrated Report **22**

Table 3.4 TMDL Watersheds Impaired by Nonpoint Source Pollution **27**

Table 4.1 Watershed Protection Plans Being Implemented or Under Development in Texas **37**

Introduction

Bald Cyprus trees line the banks of the Medina river *(Source: Thinkstock)*

Defining Nonpoint Source Pollution

Nonpoint source pollution occurs when rainfall or snowmelt flows off the land, roads, buildings, and other features of the landscape, and carries pollutants into drainage ditches, lakes, rivers, wetlands, coastal waters, and even underground sources of water. This is unlike point source pollution which results from a discharge at a specific single location. Nonpoint source pollution also includes the flow of water from sources such as leaking on-site sewage facilities, commonly known as septic systems. Some nonpoint source pollutants include:

- fertilizers, herbicides, and insecticides from agricultural lands and residential areas;
- oil, grease, and toxic chemicals from spills, roads, urban areas, and energy production;
- sediment from construction sites, crop and forest lands, and eroding stream banks;
- bacteria and nutrients from livestock, pet waste, and leaking septic systems.

Nonpoint source pollution can also originate as air pollution which is deposited onto the ground and into waterways, through a process called atmospheric deposition. Changes in the flow of waterways due to dams and other hydromodifications can also cause nonpoint source pollution.

What Guides Nonpoint Source Pollution Management in Texas?

Under the federal Clean Water Act (CWA), Texas must adopt water quality standards for waters of the state, assess the status of water quality, and implement actions necessary to achieve and maintain those standards. The long-term goal of the *Texas Nonpoint Source Management Program* is to protect and restore the quality of the state's water resources from the adverse effects of nonpoint source pollution. This is accomplished through cooperative implementation using the organizational tools and strategies defined below.

Partnerships

The Texas Commission on Environmental Quality (TCEQ) is the lead state agency responsible for establishing the level of water quality to be maintained in Texas. Primary responsibilities include the issuance of permits for point source discharges and abatement of nonpoint source pollution from sources which are not agricultural or silvicultural. The Texas State Soil and Water Conservation Board (TSSWCB) is the lead agency in the state for planning, implementing, and managing programs and practices that prevent and abate agricultural and silvicultural nonpoint source pollution. The TCEQ and TSSWCB coordinate closely to jointly administer the *Texas Nonpoint Source Management Program*.

Management of nonpoint source pollution in Texas involves partnerships with many organizations to coordinate, develop, and implement the *Texas Nonpoint Source Management Program*. With the extent and variety of nonpoint source issues across Texas, cooperation across political boundaries is essential. Many local, regional, and state agencies play an integral part in managing nonpoint source pollution. They provide information about local concerns and infrastructure and build support for the management measures that are necessary to prevent and reduce nonpoint source pollution. By coordinating with these partners to share information and resources, the state can more effectively manage its water quality protection and restoration efforts.

The Texas Nonpoint Source Management Program

The *Texas Nonpoint Source Management Program* outlines Texas' comprehensive strategy to protect and restore waters impacted by nonpoint source pollution. Nonpoint source pollution is managed through assessment, planning, implementation, and education. The state has established long- and short-term goals and objectives for guiding and tracking the progress of its nonpoint source management program. This report highlights the success in achieving these goals and objectives.

Goals for Nonpoint Source Management

Long-Term Goal

The long-term goal of the *Texas Nonpoint Source Management Program* is to protect and restore water quality affected by nonpoint source pollution through implementing the following short-term goals; data collection and assessment, implementation, and education.

Short-Term Goals

Goal One—Data Collection and Assessment

Coordinate with appropriate federal, state, regional, and local entities, and stakeholder groups to target water quality assessment activities in high priority, nonpoint source-impacted watersheds, vulnerable and impacted aquifers, or areas where additional information is needed.

Goal Two—Implementation

Implement watershed protection plans and/or Total Maximum Daily Load (TMDL) implementation plans and other state, regional, and local plans to reduce nonpoint source pollution by targeting activities in the affected areas.

Goal Three—Education

Conduct education and technology transfer activities to increase awareness of nonpoint source pollution and activities that contribute to the degradation of water bodies, including aquifers.

The Watershed Approach

Protecting the state's streams, lakes, bays, and aquifers from the impacts of nonpoint source pollution is a complex process. Texas uses the Watershed Approach to focus efforts on the highest priority water quality issues of both surface water and groundwater. The Watershed Approach is based on the following principles:

- a geographic focus based on hydrology rather than political boundaries;
- water quality objectives based on scientific data;
- coordinated priorities and integrated solutions; and
- diverse, well-integrated partnerships.

For groundwater management, the geographic focus is on aquifers rather than watersheds. Wherever interactions between surface water and groundwater are identified, management activities will support the quality of both resources.

The Watershed Approach recognizes that to achieve restoration of impaired water bodies, solutions to water quality issues must be stakeholder approved, economically bearable, and based on environmental goals.

Figure 1.1 **Social, Economic, and Environmental Considerations for Water Quality Restoration**

Watershed Action Planning

A major element in the *Texas Nonpoint Source Management Program* is the inclusion of the Watershed Action Planning (WAP) process and the Nonpoint Source Priority Watersheds Report. The WAP process is an initiative of the water quality programs in the state that guides statewide water quality planning. Management strategies to address nonpoint source water quality issues are determined through a collaborative approach and documented in the Nonpoint Source Priority Watersheds Report. This comprehensive planning process fosters relationships and facilitates greater coordination and leveraging of resources between state and local water resources agencies.

Funding limitations, new guidelines, increasing populations, and evolving environmental policies create new challenges for the state water quality planning programs. This elevates the importance of incorporating the WAP process in the Nonpoint Source Program to direct funding to watersheds with EPA accepted watershed-based plans. The WAP process encourages planning of watershed-based plans prior to implementation in order to ensure that nonpoint source funds are spent efficiently and targeted towards well-planned projects.

The WAP process supports the integration of state water quality planning programs by providing a framework and a mechanism for enhanced coordination among state water quality planning programs and stakeholders. The coordination process begins at the local level and allows stakeholders the opportunity to provide a local perspective into water quality management strategies and priorities. Interagency coordination at the state and federal level allows for more effective development of projects, leveraging of resources, and the implementation of water quality management strategies with stakeholder support.

The WAP process integrates information from existing planning tools and from the coordination process to develop and track water quality management strategies. As part of the WAP process, water quality management strategies are documented and periodically updated with the cooperation of the WAP partners which include the TSSWCB, the Clean Rivers Program partners (typically river authorities), and the five TCEQ Water Quality Planning Division program areas—Texas Surface Water Quality Standards Group, Surface Water Quality Monitoring Program, Clean Rivers Program, TMDL Program, and the Nonpoint Source Program. The result of this process is a list of all water quality impairments and special interest water bodies in the state that identifies what will be done to address the impairment or issue, the party responsible for undertaking the action, and a means of tracking progress. The recommended strategies are documented in the WAP Table, a spreadsheet summarizing the water quality management information. The WAP Table is available to the public and located on the TCEQ's website at: <http://www.tceq.texas.gov/waterquality/planning/wap/>. Data contained in the WAP table, as well as special projects associated with impaired waterbodies, are available through the WAP Public Viewer, an interactive, web-based application. Visit the WAP Public Viewer at <http://www80.tceq.texas.gov/WapWeb/public/map.htm>.

Water quality management strategies identified through the WAP process are implemented on a continuing basis. Since 2012, the WAP process has helped in the prioritization of water bodies for restoration efforts, the collection of water quality data, the adoption of TMDLs, and the completion of watershed protection plans.

San Bernard River at Fisherman's Isle *(Source: Jan and Roy Edwards)*

Progress in Improving Water Quality

North Bosque River after a heavy rain event *(Source: Texas Institute of Applied Environmental Research)*

Section 319(h) of the CWA requires that state nonpoint source annual reports include, "…to the extent that appropriate information is available, reductions in nonpoint source pollutant loading and improvements in water quality… resulting from implementation of the management program." This specifically applies to the water bodies that have previously been identified as requiring nonpoint source pollution control actions in order to "…attain or maintain applicable water quality standards or the goals and requirements of the Clean Water Act." The three primary ways of measuring improvement in water quality are through:

- measuring actual results from implementing management measures;
- calculating estimated load reductions with the help of models or other calculations; and
- long-term monitoring of the water body.

Other indicators of progress toward water quality improvements include land use or behavioral changes that are associated with reductions in loadings or pollutant concentrations in water bodies. Examples include restored riparian habitat and reduced use of fertilizers and pesticides.

Reductions in Pollutant Loadings

Geronimo Creek Septic System Decommissioning

The Alligator and Geronimo Creeks Watershed Protection Plan identifies failing septic systems in the watershed as a source of bacteria and nitrate-nitrogen. In fiscal year 2016, the City of Seguin received CWA Section 319(h) funding from TCEQ to implement a septic system decommissioning program in the annexed residential subdivision of Oak Village North. CWA Section 319(h) funds were used to decommission septic systems, and the city used funding sources outside of the 319(h) grant to connect homes to the public sewer system on a voluntary basis.

The Oak Village North subdivision was created in 1973. A 2014 report obtained from the Guadalupe County Environmental Health Department showed that only two of the existing septic systems in the subdivision had been permitted for installation within the previous ten years. According to the report, the majority of the septic systems installed in Oak Village North were over twenty years old, with the oldest being 35 years old.

A community meeting was held to give property owners detailed information about the program and encourage them to participate. The residents were given one year under this voluntary program to make the connection and decommission their tanks with the city's contractor. Follow-up e-mails, letters, and door hangers were disseminated reminding the residents of the program. The program decommissioned 131 septic systems in the community. The Environmental Health Supervisor at the City of Seguin conducted inspections during the decommissioning process and estimated that 65% of the systems were failing. Based on the 131 septic systems that were decommissioned, the program achieved the following estimated annual load reductions:

Pollutant	Load Reduction
Nitrogen	1,870 lbs[1]
E. coli	1.54 10^{16} cfu/100mL[2]

[1] lbs – pounds
[2] cfu/100mL – colony forming units per 100 milliliters

above: Septic System before decommissioning in Geronimo Creek *(Source: City of Seguin)*

right: Septic System after decommissioning in Geronimo Creek *(Source: City of Seguin)*

Arroyo Colorado Agriculture Implementation

Over the past decade, the TSSWCB has awarded CWA Section 319(h) funds to Southmost, Hidalgo, and Willacy Soil and Water Conservation Districts (SWCDs) to reduce agricultural nonpoint source pollution in the Arroyo Colorado watershed. Since 1999, 472 Water Quality Management Plans (WQMPs) covering over 33,573 acres have been implemented across the watershed.

In fiscal year 2016, 15 WQMPs were implemented in the watershed covering 465 acres. Of these 465 acres, 412 acres were cropland and 53 acres were hayland. Irrigation water best management practices (BMPs) compose the majority of implementation efforts in the Arroyo Colorado watershed. Irrigation land leveling is a common BMP implemented in the watershed that allows for the equal distribution of water across a field. This practice reduces the amount of irrigated water applied to agricultural lands, therefore, reducing potential runoff. Another common BMP used are irrigation pipelines which improve the previous water conveyance system of open ditches to a more efficient underground pipeline. This practice reduces evaporation rates and the potential for sediment runoff. A total of 291 acres of irrigation land was leveled and 2,211 feet of irrigation pipeline was installed. These two practices complement each other and have enabled producers to better utilize water resources, while reducing the potential of nonpoint source pollution. According to the Texas Best Management Practices Evaluation Tool (TBET), these BMPs achieved the following load reductions:

Pollutant	Load Reduction
Sediment	342 tons
Nitrogen	1,857 lbs
Phosphorus	535 lbs

Additional information on the efforts in the Arroyo Colorado watershed may be found at <http://www.arroyocolorado.org>.

Irrigation Land Leveling *(Source: TSSWCB)*

Lower Colorado River Authority's Creekside Conservation Program

In fiscal year 2016, the Lower Colorado River Authority (LCRA) received CWA Section 319(h) funding from the TSSWCB to continue implementation of the Creekside Conservation Program. This program is a partnership between the LCRA, private landowners, the United States Department of Agriculture - Natural Resources Conservation Service (NRCS), and local SWCDs. The Creekside Conservation Program provides technical and financial assistance to help reduce soil erosion and agricultural nonpoint source pollution on privately owned land. The program was conducted in Bastrop, Blanco, Burnet,

Colorado, Fayette, Lampasas, Llano, Matagorda, San Saba, Travis, and Wharton counties.

In fiscal year 2016, the Creekside Conservation Program provided financial assistance to ten producers with conservation projects in the program area. As a result of this effort 4,051 acres of private land were placed under conservation management, prescribed grazing, and upland wildlife habitat management practices. Additional BMPs which were installed include one alternative water supply, 34 acres of range reseeding, 4,384 feet of cross fencing, and 591 acres of brush management. Using the TBET, these BMPs achieved the following estimated load reductions:

Pollutant	Load Reduction
Sediment	6,904 tons
Nitrogen	35,255 lbs
Phosphorus	4,327 lbs

In addition to these efforts, LCRA participated in a total of eight educational events within the program area. Events included field days, new landowner meetings, and workshops with a total of 783 attendees. Additional information regarding LCRA's Creekside Conservation Program may be found at < http://www.lcra.org/community-services/land-conservation>.

LCRA Creekside Brush Management *(Source: Marshall Trigg)*

Water Quality Improvements

The TSSWCB and the TCEQ work together to identify water quality improvements where the implementation of nonpoint source BMPs is a contributing factor. Once a strong candidate is identified, a "success story" is written and sent to the United States Environmental Protection Agency (EPA) for approval.

Linking instream nonpoint source pollutant reductions to land management practices is challenging. Changes to the land can occur over varying temporal and spatial scales and contributions to the stream are rainfall driven. As a result, changes in water quality often lag behind the implementation of nonpoint source BMPs, and many years of implementation may be needed before significant improvements in a water body are observed. Despite these challenges, Texas continues to see measurable water quality improvements.

Success Story Highlights

Best Management Practices to Address Bacteria, Infrastructure Improvements, and Watershed Outreach to Improve Water Quality in the Guadalupe River Above Canyon Lake

In 2002, high levels of bacteria prompted the TCEQ to add the Guadalupe River Above Canyon Lake, Segment 1806, to the state's CWA Section 303(d) list. In 2004, the TCEQ initiated a TMDL project to conduct public outreach, identify sources, and establish load allocations. The TCEQ adopted the TMDL in 2007 and approved the TMDL Implementation Plan in 2011. The TCEQ provided the Upper Guadalupe River Authority (UGRA) with CWA Section 319(h) funding to conduct implementation in partnership with the City of Kerrville, Kerr County, and the Texas Department of Transportation (TxDOT).

To address the bacteria impairment, the TMDL Implementation Plan included BMPs to address bacteria from animal waste, infrastructure improvements, and education and outreach in the watershed. As a result of the collaborative effort of individuals and organizations, the water quality in the river has improved and Assessment Units (AUs) 1806_04 and 1806_06 are no longer on the state's impaired waters list.

Best Management Practices Implemented

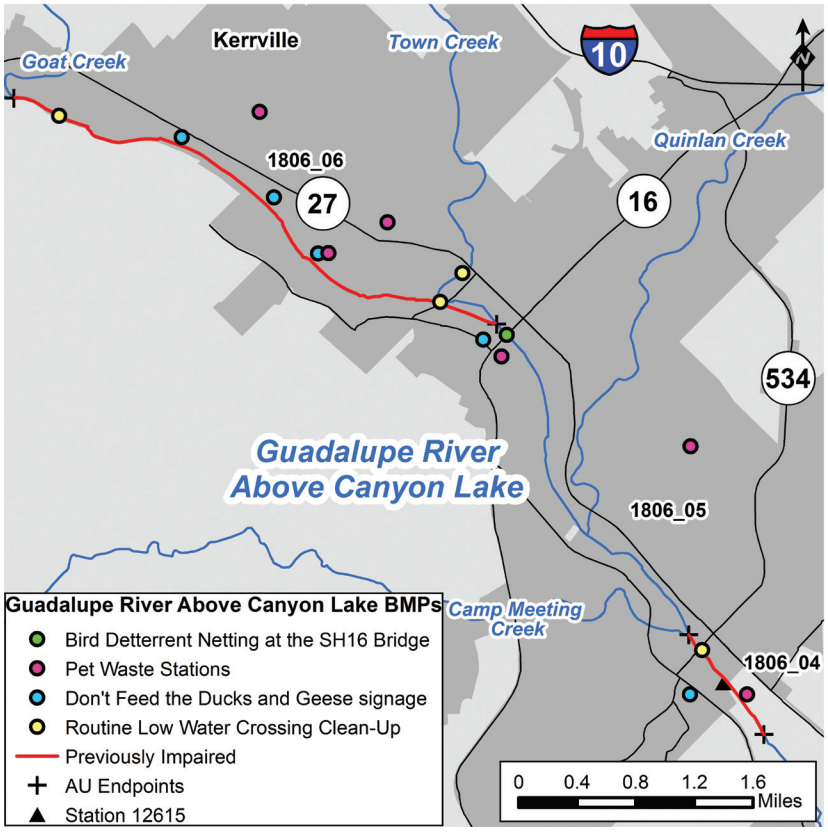
Multiple BMPs were installed on the impaired reach of Segment 1806 using CWA Section 319(h) funding from the TCEQ. Installations included 23 pet waste stations at parks around Kerrville. UGRA staff monitored the effectiveness of seven of these stations in Flat Rock Park from November 2010 to July 2014. During that time frame, an average of 18 pounds of waste per month was collected from each station. To exclude birds from roosting directly over the segment, bird deterrent structures were installed on three sections of the State

Highway 16 Bridge over the Guadalupe River in Kerrville through a partnership with TxDOT. The UGRA also partnered with the City of Kerrville to design and install "Don't Feed the Ducks and Geese" signs at five locations in Kerrville parks in an effort to reduce direct deposition of waste from waterfowl. Limited removals of waterfowl from riverside parks were also conducted.

The City of Kerrville also made several improvements to their wastewater collection infrastructure. From 2011 to 2015, the improvements included the repair or replacement of 42,675 feet of collection line, 16 lift stations, 337 sewer system access points, and 100 manholes. In addition, 150,926 feet of collection line was inspected by video camera and 804,836 feet of gravity main was cleaned. To prevent future damage to underground infrastructure 2,058 feet of tree roots in the vicinity of wastewater collection lines were removed.

To keep local stakeholders involved in the TMDL implementation and informed about water quality, the UGRA disseminated information about septic systems, broadcasted radio public service announcements, and gave an average of 25 presentations per year for the past five years throughout the watershed highlighting nonpoint source pollution issues and watershed stewardship. An annual river clean-up sponsored by UGRA also serves to raise public awareness of the impact of litter on water quality. The 2016 event had 443 participants and collected 9,200 pounds of trash from the Guadalupe River and its banks. UGRA also contracts with a local company to pick up trash at a number of low water crossings in Kerr County. A total of 477 visits to fifteen different river crossings resulted in the removal of 26,225 pounds of trash in 2016. In addition, UGRA and the City of Kerrville routinely support citizen initiated clean up groups by providing supplies and paying trash disposal fees.

Figure 2.1 **Map of BMP Locations in the Guadalupe River Above Canyon Lake Watershed**



Water Quality Improvements

Water quality monitoring data now show that both impaired AUs meet the state's water quality standard for primary contact recreation. The data collected for the 2012 and 2014 Integrated Reports led to the removal of AUs 1806_04 and 1806_06 from the impaired waters list in 2012 and 2014, respectively. These waterbodies currently support water quality standards for all of the designated uses.

The success can be attributed to the local stakeholders for developing a TMDL, TMDL Implementation Plan, and to the BMPs implemented by the UGRA in conjunction with the TCEQ, the City of Kerrville, Kerr County, and TxDOT. BMPs to address bacteria, infrastructure improvements, and education and outreach programs have decreased the bacteria load; while the trash cleanups and education and outreach programs have kept the community involved and informed. BMP implementation is ongoing and water quality monitoring is continuing to track *E. coli* levels to ensure this restoration process continues.

Implementing Conservation Practices, Repairing Failing Septic Systems and Conducting Watershed Outreach Improves Water Quality in the Leon River and South Leon River

In 1996, high levels of bacteria prompted the TCEQ to add the Leon River to the CWA Section 303(d) list of impaired waters for not supporting the primary contact recreation use. The TCEQ initiated a TMDL for the Leon River and some of its tributaries in 2002. The South Leon River was added to the 303(d) list in 2006 for the same impairment. Local stakeholders expressed interest in developing management strategies to reduce bacteria loadings within the watershed. The TSSWCB provided CWA Section 319(h) funding to develop a watershed protection plan to address the bacteria impairments in the Leon River watershed. Stakeholders within the watershed implemented

BMPs and conducted public outreach and education. Through these efforts water quality was improved. The South Leon River (AU 1221B_01) and three AUs of the Leon River below Proctor Lake (1221_01, 1221_04, and 1221_05) were removed from the state's list of impaired waters in 2014.

Best Management Practices Implemented

The TSSWCB implemented management measures identified in the Leon River Watershed Protection Plan by partnering with the Upper Leon SWCD, Mills County SWCD, and the Hamilton-Coryell SWCD to develop and implement 13 WQMPs on 4,058 acres in the watershed. These plans included alternative water sources, prescribed grazing, cross-fencing, grassed waterways, nutrient management, and grass planting. In addition, NRCS worked with landowners to implement conservation practices on over 388,600 acres using Environmental Quality Incentives Program and Agricultural Water Enhancement Program funding in the Leon River watershed and over 47,600 acres in the South Leon River watershed. The conservation practices implemented included prescribed grazing, grass and range planting, nutrient management, residue management, conservation cover, water wells, water troughs, and ponds.

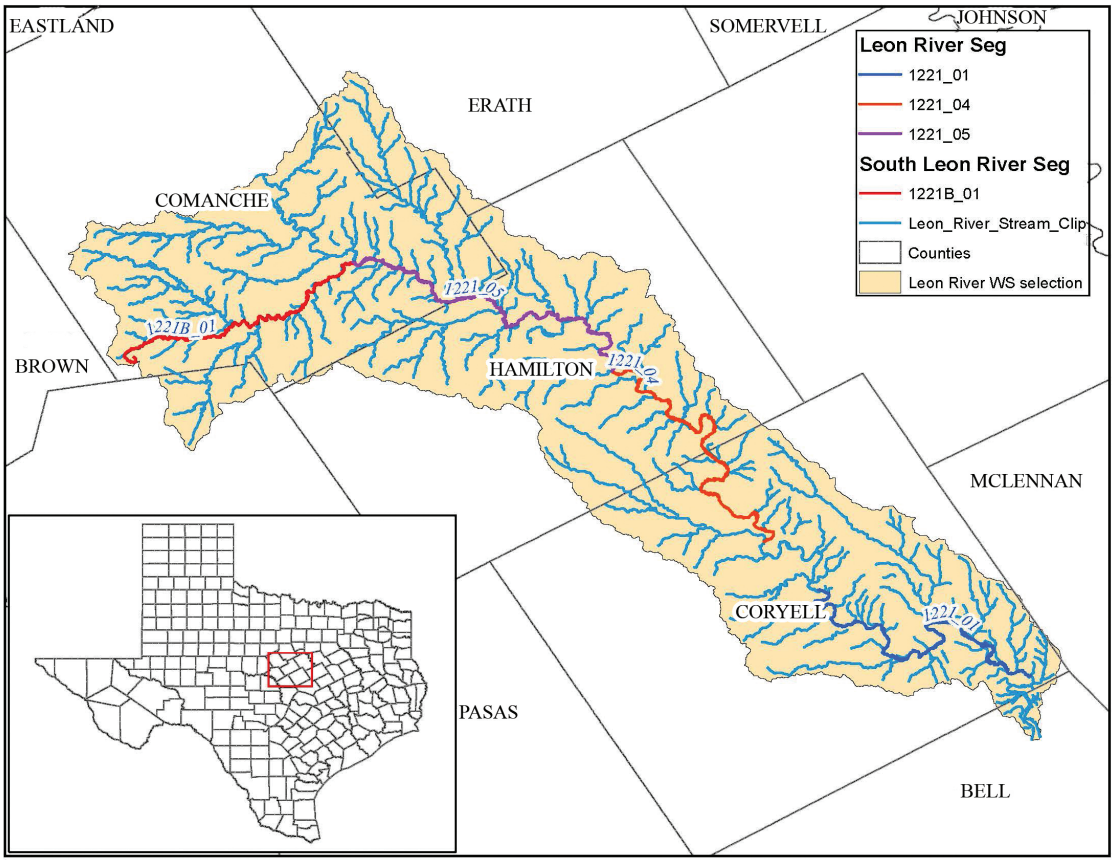
The TSSWCB also partnered with Hamilton County and Texas A&M AgriLife Extension, beginning in 2011, to repair or replace failing septic systems in the watershed. From May through November 2012, ten septic systems were repaired or replaced on or near the Leon River in Hamilton County. Implementation continued after 2012, and additional counties in the watershed have received funding to address failing septic systems.

Water Quality Improvements

Water quality monitoring data show that the long-term *E. coli* geometric means meet the state water quality standard for contact recreation in several portions of the Leon River. Water quality data collected for the 2014 Integrated Report from 2005-2012 led to the removal of three AUs of the Leon River (1221_01, 1221_04, and 1221_05) and the South Leon River (AU 1221B_01) from the impaired waters list. These waterbodies currently support all of their designated uses.

The success can be attributed to increased stakeholder awareness due to the watershed planning process, repaired or replaced septic systems, and conservation practices being implemented in the watershed. Water quality monitoring continues to track and measure progress of the Leon River Watershed Protection Plan and ensure this restoration effort remains a success.

Figure 2.2 **The Leon River Watershed with De-Listed AUs Highlighted**



Progress Toward Meeting the Goals and Objectives of the Texas Nonpoint Source Management Program

Llano River *(Source: Thinkstock)*

The TCEQ and the TSSWCB have established goals and objectives for guiding and tracking the progress of nonpoint source management in Texas. The goals describe high-level guiding principles for all activities under the *Texas Nonpoint Source Management Program*. The objectives specify the key methods that will be used to accomplish the goals. Although not comprehensive, this chapter reports on a variety of programs and projects that directly support the goals and objectives of the *Texas Nonpoint Source Management Program*.

Clean Water Act Section 319(h) Grant Program

Section 319(h) of the CWA established a grant that is appropriated annually by Congress to the EPA. The EPA allocates these funds to the states to implement activities supporting the Congressional goals of the CWA. The TCEQ and the TSSWCB target these grant funds toward nonpoint source activities consistent with the long- and short-term goals defined in the *Texas Nonpoint Source Management Program*.

The grant funds can support a wide variety of activities including implementation of BMPs, technical assistance, financial assistance, education, training, technology transfer, and monitoring to assess the success of specific nonpoint source implementation projects. In fiscal year 2016, Texas received $7,371,000 in CWA Section 319(h) federal grant funds to utilize and award to sub-grantees across the state.

Status of Clean Water Act Section 319(h) Grant-Funded Projects

In fiscal year 2016, the TCEQ had 33 active CWA Section 319(h) grant-funded projects totaling approximately $9.5 million, which addressed a wide range of nonpoint source issues (Figure 3.1). A primary focus of these projects was the development and implementation of watershed protection plans to address urban nonpoint sources, targeted outreach and education, low impact development (LID) projects and TMDL implementation activities.

Figure 3.1 **TCEQ Fiscal Year 2016 Nonpoint Source Grant Funds**

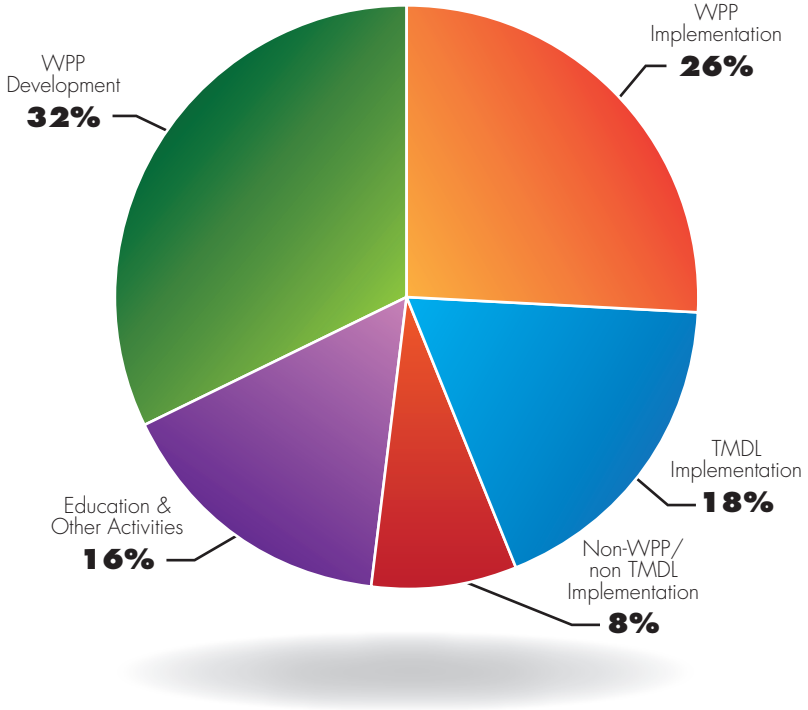
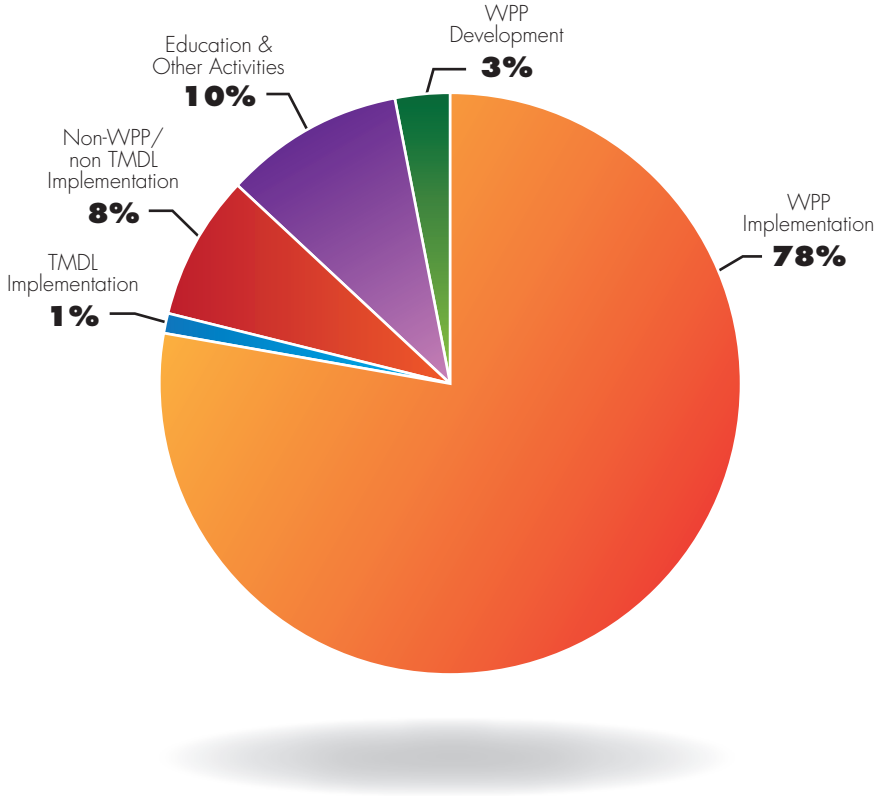


Figure 3.2 **TSSWCB Fiscal Year 2016 Nonpoint Source Grant Funds**



In fiscal year 2016, the TSSWCB had 36 active CWA Section 319(h) grant-funded projects totaling approximately $8.5 million, which addressed both agricultural and silvicultural nonpoint source pollution (Figure 3.2). Specific projects included developing and implementing watershed protection plans, implementing TMDLs, supporting targeted educational programs, and implementing BMPs to abate nonpoint source pollution from agricultural and silvicultural operations.

Short-Term Goals and Milestones of the Texas Nonpoint Source Management Program

Goal One— Data Collection and Assessment

One of the goals of the *Texas Nonpoint Source Management Program* is to collect and assess water quality data. Data collection requires the coordination of appropriate federal, state, regional, and local entities as well as private sector and citizen groups. The TCEQ's Surface Water Quality Monitoring Program, operating from the Austin central office and 16 regional offices, conducts both routine ambient monitoring and special studies. In addition, the Clean Rivers Program, which is a collaboration between the TCEQ and 15 regional water agencies, collects surface water quality data throughout the state in response to both state needs and local stakeholder interests. Furthermore, the TCEQ acquires water quality data from other state and federal agencies, river authorities, and municipalities after assuring the quality of the data is comparable to that of data collected by the TCEQ's programs.

Data are assessed by the TCEQ to determine if a water body meets its designated uses or if water quality improvement activities are achieving their intended goals. For impaired waters, water quality data can be used in the development of watershed protection plans and TMDLs. Data are also used to determine potential sources of pollution and the adequacy of regulatory measures, watershed improvements, and restoration plans. The data collection guides the distribution of CWA Section 319(h) grant funds toward water quality assessment activities in high priority watersheds, nonpoint source-impacted watersheds, vulnerable and impacted aquifers, or areas where additional information is needed.

Texas Integrated Report

The Integrated Report describes the status of all surface water bodies of the state evaluated for the given assessment period. The TCEQ uses data collected during the most recent seven to ten year period to assess the quality of surface water bodies of the state. The descriptions of water quality for each assessed water body in the Integrated Report represent a snapshot of conditions during the time period considered in the assessment. Water bodies identified as impaired by nonpoint source pollution are given priority for CWA Section 319(h) grants through the WAP process. The assessment guidance includes methods to determine designated use attainment for water quality standards. These methods are developed by the TCEQ with the advice of a diverse group of stakeholders. The 2014 Integrated Report was approved by the TCEQ in June 2015 and by the EPA in November 2015. The assessment methods for the 2014 Integrated Report are detailed in the *2014 Guidance for Assessing and Reporting Surface Water Quality in Texas* (available online at <https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/14txir/2014_guidance.pdf>.

Water Quality Status Categories

The Integrated Report assigns each assessed water body to one of five categories in order to report water quality status and potential management options to the public, the EPA, state agencies, federal agencies, municipalities, and environmental groups. These categories indicate the status of a water body and describe how the state will approach identified water quality problems. Table 3.1 defines the five categories and shows the number of water bodies assigned to each assessment category in the 2014 Integrated Report.

The 303(d) list (Category 5 of the Integrated Report) identifies waters that do not meet Texas surface water quality standards. It is an important management tool produced as part of the Integrated Report. The 303(d) list must be approved by the EPA. Water bodies on the 303(d) list are those that require action to restore water quality. An impairment occurs when a water body does not meet a pollutant standard for a specific use. The same AU can have multiple impairments. For example, a water body may not meet the standard for both dissolved oxygen and bacteria; this is considered two impairments. This explains why the total number of impairments in Table 3.2 is greater than the number of water bodies in Category 5 in Table 3.1. Since a water body has multiple uses, it may fall into different categories for different uses. In that case, the overall category for the water body is the one with the highest category number.

The Integrated Report further divides Category 5 water bodies into subcategories to reflect additional options for addressing impairments:

- Water bodies in Category 5a have a TMDL underway, scheduled, or to be scheduled.
- Water bodies in Category 5b require a review of the water quality standards for the water body to be conducted before a management strategy is selected.
- Those water bodies in Category 5c require additional data and information to be collected or evaluated before a management strategy is selected.

Table 3.2 shows the total number of impairments in the 2014 Integrated Report broken down by the category designation. The categories must be applied to each combination of water body and parameter for determining support.

Table 3.1 **Number of Water Bodies Assigned to Each Assessment Category in the 2014 Integrated Report**

Category	Definition	Number of Water Bodies
1	Attaining all the water quality standards and no use is threatened.	85
2	Attaining some of the designated uses, no use is threatened, and insufficient or no data and information are available to determine if the remaining uses are attained or threatened.	336
3	Insufficient or no data and information to determine if any designated use is attained. Many of these water bodies are intermittent streams and small reservoirs.	127
4	The standard is not supported or is threatened for one or more designated uses but does not require the development of a TMDL.	104
5	The water body does not meet applicable water quality standards or is threatened for one or more designated uses by one or more pollutants. Category 5 is the *CWA Section 303(d) List.*	401
Total		**1053**

Table 3.2 **Number of Impairments in the 2014 Integrated Report**

Category	Definition	Water Body Classification		Total Number of Impairments by Category
		Classified	Unclassified	
5	5a—TMDL scheduled or underway	77	55	132
	5b—Water Quality standards review scheduled or under way or undergoing Use Attainability Analysis	55	118	173
	5c—Need additional monitoring	162	127	289
Total Number of Impairments in Category 5		**294**	**300**	**594**

Table 3.3 **Summary of Impairments in the 2012 Versus 2014 Integrated Report**

Impairment Group	Media	2012 Number of Impairments	2014 Number of Impairments	Use
Bacteria	in water	257	243	recreation
	in water	0	2	general use
	in shellfish	15	8	oyster waters
	beaches	1	2	beach use
Dissolved oxygen	in water	90	96	aquatic life
Toxicity	in ambient water	2	2	aquatic life
	in ambient sediment	6	6	
Organics	in water	0	0	fish consumption, aquatic life
	in fish or shellfish	99	114	
Metals (except mercury)	in water	4	6	fish consumption, oyster waters, aquatic life
	in fish or shellfish	0	0	
Mercury	in water	1	1	fish consumption, oyster waters, aquatic life
	in fish or shellfish	23	24	
Dissolved solids	chloride	11	17	general
	sulfate	9	12	
	total dissolved solids	14	18	
Temperature	in water	0	1	general
pH	in water	17	17	general
Nutrients	nitrogen	0	0	general, public water supply
Biological	habitat, macrobenthic community, or fish community	19	20	aquatic life
Totals		**568**	**589**	

Summary of the 2014 Integrated Report

The 2014 Integrated Report assessed the water quality of 1,409 water bodies. Sufficient data was available to assess uses for 1,053 water bodies which resulted in 589 impairments (Table 3.3). Of the 1,409 water bodies, 401 were classified as Category 5 water bodies (Table 3.1) with a total of 594 impairments (Table 3.2). The number of impairments by category shown in Table 3.2 is greater than the number of impairments shown in Table 3.3 for 2014 because a segment may have AUs in different subcategories of Category 5. The number of water bodies classified as Category 5 was a slight decrease from the 2012 CWA Section 303(d) list, which included 410 water bodies, while the total number of impairments increased from 568.

Summary of Impairments on the 2014 Integrated Report

Impairments identified in the 2014 Integrated Report have been grouped by the parameter and the beneficial use of the water body affected (Table 3.3). Elevated levels of bacteria represent the majority of the listed impairments. Many of these bacteria impairments are the result of urban and agricultural nonpoint source pollution. Low dissolved oxygen, impairing many of the same water bodies, was also found to be a leading cause of impairments.

Continuous Water Quality Monitoring

The TCEQ has a network of continuous water quality monitoring sites on priority water bodies. The agency maintains 45-60 sites in its Continuous Water Quality Monitoring Network (CWQMN). The number and locations of sites varies from year to year. In fiscal year 2016, the TCEQ had 45 active sites. At these sites, instruments measure basic water quality conditions every 15 minutes. CWQMN monitoring data may be used by the TCEQ or other organizations to make water resource management decisions, target field investigations, evaluate the effectiveness of water quality management programs such as TMDL implementation plans and watershed protection plans, characterize existing conditions, and evaluate spatial and temporal trends. Site information and data are available online at <https://www.tceq.texas.gov/waterquality/monitoring/swqm_realtime.html>. The monitoring network is used to guide decisions on how to better protect certain rivers and lakes.

A Continuous Ambient Monitoring System (CAMS 730) was deployed on the Arroyo Colorado near Rio Hondo, Texas, to gather data to support the Arroyo Colorado Watershed Protection Plan. This monitoring device continuously measures dissolved oxygen near the surface of the water and incorporates advanced active and passive anti-fouling methods to improve overall data quality.

Data from the CAMS 730 station was used to conduct water quality modeling for an update to the Arroyo Colorado Watershed Protection Plan. The data collected from the CAMS 730 station were compared to data obtained from manually deployed 24-hour multiprobes nearby. Data were used to characterize the dissolved oxygen issues, evaluate temporal trends, and identify when periods of low dissolved oxygen are likely to occur.

The CAMS 730 station has provided the most comprehensive dataset to date regarding the dissolved oxygen impairment in the Arroyo Colorado Tidal segment. Data from March 2015 to February 2016 were analyzed, plotted, and included in the draft update to the Arroyo Colorado Watershed Protection Plan. CAMS 730 station data demonstrated the seasonality of the dissolved oxygen impairment and provided information to target the ideal time of the year to utilize BMPs.

Figure 3.3 **Continuous Water Quality Monitoring Stations**

Texas Stream Team Monitoring

Texas Stream Team is a statewide network of citizen scientists, and partner organizations that is dedicated to monitoring water quality through data collection, stakeholder engagement, and watershed education. The program is based out of The Meadows Center for Water and the Environment at Texas State University, and is administered through a cooperative CWA Section 319(h) grant funded partnership with The Meadows Center for Water and the Environment, the TCEQ, and the EPA.

Texas Stream Team citizen scientists are certified under a training process to collect water quality parameters from assigned sites along rivers, lakes, and streams. The water quality parameters include temperature, pH, dissolved oxygen, specific conductance, water turbidity, *E. coli*, nitrate-nitrogen, orthophosphate, and field observations. The data are collected in accordance with an approved Quality Assurance Project Plan. After undergoing a quality assurance check, the data are posted onto Texas Stream Team's Dataviewer, <https://aqua.meadowscenter.txstate.edu/>, an interactive database/map, where visitors can click on a specific site and download the historical water quality data that have been collected.

Watershed-wide data are also compiled and analyzed in summary reports which are available to partner organizations, local water resource managers, local stakeholders, citizen scientists, and the general public in order to give a more complete picture of the quality of local water bodies. In fiscal year 2016, Texas Stream Team published summary reports of citizen scientists' data in the Salado Creek, Geronimo Creek, Carters Creek, and Lake Worth watersheds.

In fiscal year 2016, Texas Stream Team and its partners trained 282 volunteers in water quality monitoring. Citizen scientists volunteered 4,277 hours of their time and conducted 2,128 monitoring events on rivers, lakes, and streams across Texas. An average of 580 monthly participants drove a total of 47,942 miles throughout the year to collect data on 232 active sites. Many of these monitoring events took place on water bodies where there is a watershed protection plan such as Geronimo Creek and Cypress Creek, or where a TMDL is being implemented such as Carters Creek. The data collected by citizen scientists helps watershed coordinators and stakeholders to better understand the environmental conditions of their waters. In addition to water quality monitoring, the Texas Stream Team staff and partners provided watershed education to 2,185 people on nonpoint source pollution and other water quality issues in fiscal year 2016. The Meadows Center for Water and the Environment aims to use its location at Spring Lake, located at the headwaters of the San Marcos River, to offer watershed education to visitors. The Meadows Center for Water and the Environment's Spring Lake Outdoor Education Program offers educational activities to visiting students from schools across the state.

Texas Stream Team has a suite of interactive demonstrations that can be offered to students from elementary schools, middle schools, and high schools. This includes using the Texas Stream Team Water Quality Monitoring Kit to demonstrate water quality sampling, and the Enviroscape 3D Watershed Model to demonstrate sources of pollution in a watershed. In fiscal year 2016, Texas Stream Team gave nine presentations to 581 students at Spring Lake. In addition, Texas Stream Team staff held 19 education and outreach events around the state and reached an additional 1,604 people.

Texas Stream Team staff member educating citizens on water quality monitoring *(Source: Texas Stream Team)*

Goal Two—Implementing Programs to Reduce Nonpoint Source Pollution

The second goal of the *Texas Nonpoint Source Management Program* is to implement activities that prevent and reduce nonpoint source pollution in surface water, groundwater, wetlands, and coastal areas. The objective of this goal is to implement watershed protection plans, TMDL implementation plans, the Texas Groundwater Protection Strategy, TSSWCB-certified WQMPs, as well as implementation of BMPs on agricultural and silvicultural lands, and other identified priorities.

Implementation Project Highlights

Upper Cibolo Creek

The City of Boerne received CWA Section 319(h) funding from the TCEQ to implement management measures in the EPA accepted Upper Cibolo Creek Watershed Protection Plan.

Outreach and education, domestic waterfowl management, long-term water quality monitoring, and efforts to promote LID are the primary strategies utilized to address the bacteria impairment and nutrient concerns throughout the watershed.

Sponsored by the City of Boerne, the Upper Cibolo Creek Watershed Partnership has worked to engage a variety of stakeholders through presentations, workshops, newsletters, and an active social media campaign. A successful component of the outreach effort is the ongoing partnership between the City of Boerne, Cow Creek Groundwater Conservation District, and the Boerne Independent School District to bring water quality protection and water conservation presentations to seventh grade science students. The program educates students on watershed management, local surface water and groundwater interactions, existing water quality impairments on Upper Cibolo Creek, and residential water conservation techniques. Presentations highlight ways students have an impact on local water quality conditions through proper disposal of pet waste and not feeding local domestic waterfowl. The program has reached over 2,500 students since 2011.

Beginning in 2015, the Watershed Partnership has worked with Keep Boerne Beautiful to organize annual clean-ups to remove litter and flood debris along waterways. In 2016, over 100 volunteers spent four hours along a one mile stretch of the Upper Cibolo Creek at Boerne City Park and the Cibolo Nature Center. Volunteers removed 50 bags of trash, 13 highway road barrels, one portable toilet, a five gallon fuel can, and three tires from the creek.

The City of Boerne is implementing a long-term waterfowl management program to reduce instream bacteria loads from domestic waterfowl. The program aims to reduce and maintain domestic waterfowl populations on Upper Cibolo Creek at River Road Park through capture and relocation events and egg oiling. The City of Boerne also installed "Do not feed waterfowl" signs along River Road Park to discourage citizens from feeding waterfowl. As of fiscal year 2016, the target population has been reached and efforts are ongoing to maintain the current domestic waterfowl population.

The City of Boerne is partnering with the San Antonio River Authority to create a Boerne edition of the *San Antonio River Basin Low Impact Development Technical Guidance Manual*. The technical guidance manual will be used to promote LID strategies to improve water quality from urban runoff throughout the City of Boerne. This technical guidance manual and other management measures are being implemented to protect portions of the Upper Cibolo Creek watershed within the City of Boerne that are experiencing significant residential and commercial growth.

Upper Cibolo Creek *(Source: City of Boerne)*

Lower Nueces River

The identification of a leaking tar bucket during an investigation of an oil sheen on the Nueces River resulted in stakeholder interest to investigate possible debris in the river. The Nueces River Authority (NRA) later received CWA Section 319(h) funding from the TSSWCB to develop a watershed protection plan for the Lower Nueces River. The plan was accepted by the EPA in April 2016. During the development of the plan, the NRA partnered with Blackland Texas A&M AgriLife Research and Extension Center to conduct a side-scan sonar survey of the river.

The removal of large debris identified by the survey was included as a management measure in the Lower Nueces River Watershed Protection Plan. The NRA worked with stakeholders and members of the Nueces River Preservation Association to review the results of the survey and develop a list of objects to be removed from the river. This included ten partially submerged boats and one collapsed pier. Other objects identified during the survey were considered to be better left undisturbed as they were not detrimental to water quality, recreation, or navigation.

The success of the large debris removal was made possible by the collaboration of a number of entities. In addition to the CWA Section 319(h) funding of the side-scan sonar survey, the NRA utilized funding from the Coastal Bend Bays and Estuaries Program (CBBEP) to contract with J. M. Davidson Inc. to perform the debris removal in May 2016. The Nueces River Preservation Association investigated and tagged items to be removed and the City of Corpus Christi Solid Waste Department provided the debris disposal. Nueces County funded expenses associated with debris removal equipment. For more information on the Lower Nueces River visit <http://www.nuecesriverpartnership.org/>.

Debris Removal in the Lower Nueces River *(Source: NRA)*

Total Maximum Daily Loads and Implementation Plans

The TMDL program develops targets for reducing pollution and helps communities build plans to improve water quality in local waterways. TMDL implementation plans may be developed concurrently with TMDLs to leverage resources and increase the pace at which Texas improves impaired waterways. Stakeholders provide the local expertise for identifying site-specific problems, targeting areas for attention, and determining what measures will be most effective. Ultimately, it is stakeholders who implement the plans to improve water quality in the rivers, lakes, and bays and achieve long-term success.

Several TMDL implementation plans are supported by CWA Section 319(h) grants. These include implementation plans for contact recreation in the Houston–Galveston Region and the Greater Trinity Region. As of August 2016, stakeholders were implementing 166 TMDLs under 20 approved implementation plans for waterways that are impaired, in part, by nonpoint source pollution (Table 3.4).

Table 3.4 **TMDL Watersheds Impaired by Nonpoint Source Pollution**

Uses of Concern & Watershed Name	Status of Restoration[1]	Links to Project Websites
Aquatic Life		
Lake O' the Pines	Underway	www.tceq.texas.gov/waterquality/tmdl/nav/19-lakepines/19-lakepines.html
Contact Recreation		
Austin Area Watersheds	Underway	www.tceq.texas.gov/waterquality/tmdl/101-austinbacteria
Armand Bayou	Underway	www.tceq.texas.gov/waterquality/tmdl/23-armandbayou.html
Carters Creek	Underway	www.tceq.texas.gov/waterquality/tmdl/85-carterscreek.html
Houston–Galveston Region	Some Improvement	www.tceq.texas.gov/waterquality/tmdl/nav/42-houstonbacteria/42-big-houstonarea
Gilleland Creek	Underway	www.tceq.texas.gov/waterquality/tmdl/nav/69-gillelandcreekbacteria/69-gillelandcreekbacteria.html
Guadalupe River Above Canyon Lake	Restored	www.tceq.texas.gov/waterquality/tmdl/nav/65-guadalupe/65-guadalupebacteria
Greater Trinity Region	Underway	www.tceq.texas.gov/waterquality/tmdl/nav/66-greatertrinitybacteria/66-trinityimplementation
Mission and Aransas Rivers	Underway	www.tceq.texas.gov/waterquality/tmdl/42-copano.html
Upper San Antonio River	Underway	www.tceq.texas.gov/waterquality/tmdl/34-uppersanantoniobac.html
Fish Consumption		
Arroyo Colorado	Some Improvement	www.tceq.texas.gov/waterquality/tmdl/07-arroyoleg.html
Trinity River Basin in Dallas & Tarrant Counties	Some Improvement	www.tceq.texas.gov/waterquality/tmdl/05-dalleg.html
Trinity River Basin in Fort Worth	Some Improvement	www.tceq.texas.gov/waterquality/tmdl/02-fwleg.html
Lake Worth	Underway	www.tceq.texas.gov/waterquality/tmdl/63-lakeworthpcbs.html
General		
Clear Creek	Restored	www.tceq.texas.gov/waterquality/tmdl/08-ccchlor.html
Colorado River Below E.V. Spence Reservoir	Restored	www.tceq.texas.gov/waterquality/tmdl/nav/32-colorado/32-colorado.html
E.V. Spence Reservoir	Some Improvement	www.tceq.texas.gov/waterquality/tmdl/04-spence.html
North Bosque River	Significant Improvement	www.tceq.texas.gov/waterquality/tmdl/06-bosque.html
Petronila Creek	Underway	www.tceq.texas.gov/waterquality/tmdl/nav/32-petronila/32-petronila-tds
Public Water Supply		
Aquilla Reservoir	Restored	www.tceq.texas.gov/waterquality/tmdl/10-aquilla.html

[1] *Restored only for the parameters addressed in the TMDL implementation plan; the waterway may have other impairments.*

Texas Coastal Management Program

The Texas Coastal Management Program (CMP) was created to improve coastal management and ensure the long-term economic and ecological productivity of the coast. The Texas General Land Office (GLO) administers the CMP, and is advised by members of the Coastal Advisory Committee which includes staff from the TCEQ, TSSWCB, Texas Parks and Wildlife, and TxDOT.

The Coastal Zone Act Reauthorization Amendments (CZARA), Section 6217 of the Federal Coastal Management Act, requires coastal states with approved CMPs to develop and implement a federally approved program to control nonpoint source pollution in the coastal zone. These nonpoint source management programs are required to implement management measures in accordance with guidance published by EPA. The majority of the Texas Coastal Nonpoint Source Management Program (TXCNPS) has been approved; however, six management measures still need to be addressed relating to septic systems, urban issues, and non-TxDOT roads, highways, and bridges. The GLO and members of the Coastal Advisory Committee continue to work in coordination with EPA and the National Oceanic and Atmospheric Association to implement the TXCNPS and address these measures.

Operating Septic Systems

The Texas Nonpoint Source Program is implementing several projects to satisfy CZARA requirements to inspect on-site sewage disposal systems, or septic systems, in the coastal zone. Texas A&M AgriLife Extension, with CWA Section 319(h) funding from the TCEQ, implemented a project designed to identify, inspect, and remediate failing septic systems in the coastal zone. In fiscal year 2016, remediation efforts were focused in Brazoria, Galveston, and Chambers counties. A total of 12 septic systems were inspected with an age range of 15 to 50 years. Nine of the inspected systems were pumped out and four were replaced. Approximately 3,300 gallons of septage were removed from the systems.

Another important project, locating septic systems in the coastal zone, is being implemented. This project uses existing information, "911" emergency response address information, wastewater system service areas, and other information to identify, locate, and characterize septic systems in the coastal zone. The inventory of septic systems identifies systems that meet the applicability criteria for upgrading systems near nitrogen-limited surface waters specified in the CZARA guidance. Texas will complete and implement a strategy for replacing or upgrading these systems.

Texas A&M AgriLife Extension is also implementing a project to inventory the current number of time-of-transfer septic system inspections conducted during real estate transactions in the coastal zone. The project will promote and report the use of time-of-transfer septic system inspections in the coastal zone.

Urban Runoff

In fiscal year 2016, Texas continued work on an inventory of urban runoff management practices currently used in the coastal zone to determine areas where Section 6217 management measures are not met. Based upon this information, Texas will design and implement a targeted program to promote and document the use of stormwater management practices. The program will include education and outreach, and technical and financial assistance. The program will target community officials, land owners, land developers, engineers, financiers, and other local land development professionals and interest groups to emphasize the goal of institutionalizing the use of sustainable stormwater management practices.

Roads, Highways, and Bridges for Non-TxDOT Facilities

In fiscal year 2016, Texas continued work on an inventory of roadway management practices currently used in the coastal zone to determine areas where Section 6217 management measures are not met. Based upon this information, Texas will design and implement a targeted assistance program to promote and document the use of sustainable coastal roadway management practices. TxDOT guidance for roadway planning, design, operation, and maintenance will be promoted for use on non-TxDOT roadways. The program will include education and technical assistance and will target public officials with jurisdictional responsibilities for managing coastal non-TxDOT roadways. The goal of the program will be to institutionalize the use of sustainable coastal roadway management practices within each community and jurisdictional area.

Estuary Programs in Texas

Galveston Bay Estuary Program

The Galveston Bay Estuary Program (GBEP) is one of 28 National Estuary Programs in the United States and works with local stakeholders to provide comprehensive ecosystem management through collaborative partnerships to ensure preservation of the bay's multiple uses. Specifically, the GBEP is charged with implementing *The Galveston Bay Plan*—a Comprehensive Management Plan for Galveston Bay. The GBEP addresses nonpoint source pollution through development and implementation of watershed protection plans, nonpoint source outreach and education, and structural and nonstructural water quality improvement BMPs.

Cease the Grease Campaign

In fiscal year 2016, the GBEP continued to support the City of Nassau Bay's successful Cease the Grease Campaign (http://

Cease the Grease *(Source: GBEP)*

www.ceasethegrease.net), a public education and outreach campaign which aimed to educate residents in the lower Galveston Bay watershed about proper grease disposal. This campaign was adopted from upstream partner Dallas Water Utilities, which successfully launched a Cease the Grease Campaign in 2005, and has seen a significant reduction in the occurrence of monthly sanitary sewer overflows. Dallas Water Utilities provided campaign and marketing materials free of cost, allowing for significant cost-savings. The Galveston Bay Foundation adapted materials to produce consistent messaging throughout the Galveston Bay watershed.

Sanitary sewer overflows from fats, oil, and grease are a source of concern for harmful bacteria found in Galveston Bay. Aging infrastructure, combined with the improper disposal of fats, oils, and grease in single and multi-family homes, can lead to costly problems for both local governments and citizens in terms of sewer lines, home plumbing repairs, and environmental remediation. Cease the Grease is directed towards four target audiences: homeowners, apartment dwellers, schools, and restaurants.

The City of Nassau Bay, which subcontracted with the Galveston Bay Foundation for the management of this campaign, also partnered with the cities of Baytown, Friendswood, Pearland, League City, Houston, and La Porte for a consistent message and regional approach to grease management. A partnership with a local NBC affiliate in Houston led to the dissemination of outreach materials during the 2015 holiday season, resulting in over 601,000 impressions via online click-thru and television broadcastings and 126,698 via YouTube video ads. The Galveston Bay Foundation participated in a number of events in 2016, including Trash Bash, career days, and the Bay Day Festival. The Galveston Bay Foundation provided campaign information, distributed materials, and demonstrated sanitary sewer overflows caused by fats, oils, and grease through educational games. Campaign effectiveness will be measured by a reduction in grease-related sanitary sewer overflows and questionnaire data in outreach programs. Galveston Bay Foundation initiated an educational program with elementary-aged children called *Water Warriors*, where Galveston Bay Foundation presents materials and provides curriculum to teachers about the improper disposal of fats, oils, and grease. The children sign a pledge and receive a certificate for their commitment. Future campaign efforts include providing education and outreach materials in Spanish and the installation of grease recycling stations in the lower Galveston Bay watershed.

Coastal Bend Bays and Estuaries Program

The CBBEP, located in the Corpus Christi area, is another one of the 28 National Estuary Programs that works with local government, stakeholders, conservation groups, industry, and resource managers to improve water quality and restore critical habitats. The CBBEP targets nonpoint source pollution issues by conducting research projects to determine sources of pollution. In addition, the CBBEP participates in the development and implementation of watershed protection plans and TMDL implementation plans. Other CBBEP priority focus areas include land conservation and management and education through the Delta Discovery program.

Baffin Bay

In 2016, the CBBEP focused efforts in Baffin Bay, a hypersaline bay that historically has harmful algal blooms, periods of depleted oxygen, and fish kills. The CBBEP was integral in the establishment of the Baffin Bay Study Group in 2012. This group brought together scientists, natural resource managers, guides, and other bay users to support interests in resolving Baffin Bay water quality and biological productivity concerns. In 2016, the CBBEP established a volunteer water quality monitoring program and a datasonde network for continuous water quality monitoring. The group is now helping the bay system by addressing water quality concerns through development of a watershed protection plan to identify and address pollutant sources.

Texas Groundwater Protection Committee

Groundwater is a major source of water in Texas, providing about half of the 15.2 million acre-feet of water used in the state. Texas' groundwater is used as drinking water for people and livestock, irrigation for crops, and in mining and industrial processes. It also serves as habitat for plants and animals, some of which are endangered species. The Texas Groundwater Protection Committee (TGPC) was established by the Texas Legislature in 1989 as an interagency committee to manage this essential resource. The TGPC consists of nine state entities and an association of

groundwater districts. The TGPC strives to improve interagency coordination in the area of groundwater quality protection, and continues developing and updating the comprehensive groundwater protection strategy for the state. The TGPC also identifies areas where new programs could be created, or existing programs could be enhanced, to provide added protection.

Two subcommittees, the Groundwater Issues Subcommittee and the longstanding Public Outreach and Education Subcommittee, execute the majority of the TGPC's responsibilities. Both the Groundwater Issues Subcommittee and the main TGPC have standing agenda items at every meeting for discussion of nonpoint source pollution issues. The Groundwater Issues Subcommittee oversees the cooperative groundwater monitoring program for pesticides in groundwater, which monitors aquifer conditions for select pesticides of interest.

Because contamination of groundwater is easier to prevent than it is to clean up, the TGPC emphasizes groundwater awareness in their outreach and education efforts. Targeting primarily rural Texans, the Public Outreach and Education Subcommittee worked with partner agency Texas A&M AgriLife Extension Service to develop Fact Sheets and Frequently Asked Questions that include nonpoint source pollution information and management practices. Several thousand copies of the Fact Sheets were distributed during visits to the TGPC's traveling display during 14 Austin area events in fiscal year 2016. The TGPC supported AgriLife Extension in conducting several educational events for water well owners and disseminating literature while screening 825 water well samples from 22 counties for basic groundwater quality data. For more information visit the TGPC's website at <http://tgpc.state.tx.us/>.

Clean Water State Revolving Fund Loans for Nonpoint Source Projects

Another tool available in Texas for addressing nonpoint source pollution is the Clean Water State Revolving Fund (CWSRF), which is administered by the Texas Water Development Board (TWDB). The CWSRF is a financing program authorized under the federal CWA and is partially capitalized by an annual grant from the EPA. This program provides funding assistance in the form of up to 30 year loans at interest rates lower than the market offers, as well as a limited amount of funds which do not have to be repaid. The funds that do not have to be repaid are available to disadvantaged communities as well as for green projects. Although the majority of funds finance publicly owned wastewater treatment and collection systems, the TWDB can also provide CWSRF for nonpoint source pollution abatement and stormwater projects. Funds are available to cities, counties, groundwater conservation districts, SWCDs, and other public agencies, as well as to nonprofit organizations, mainly water supply and/or sewer service corporations.

A water quality-based priority system is used to rank potential applicants and fund projects, including nonpoint source projects. To be eligible, a nonpoint source project must be an identified practice within a WQMP, TMDL implementation plan, or watershed protection plan; a nonpoint source management activity that has been identified in the *Texas Groundwater Protection Strategy*; or a BMP identified in the *Texas Nonpoint Source Management Program* or the National Estuary Program. Loans can be used for planning, designing, acquiring, and constructing wastewater treatment facilities, wastewater recycling and reuse facilities, and collection systems. Other activities eligible for funding assistance include agricultural, rural, and urban runoff control; estuary improvement; nonpoint source education; and wet weather flow control, including stormwater management activities.

The TWDB has increased its efforts to identify potential applicants for loan projects that would address water quality problems associated with nonpoint source pollution in the state. Staff members from the TWDB, the TCEQ, and the TSSWCB meet regularly to coordinate efforts to identify water bodies that are impacted by nonpoint source pollutants and to identify potential applicants for CWSRF assistance. They also identify potential candidates for Green Project Reserve funding, which can provide some loan forgiveness if LID practices are constructed.

Goal Three—Education

The third goal of the *Texas Nonpoint Source Management Program* is to conduct education and technology transfer activities to raise awareness of nonpoint source pollution and activities that contribute to the degradation of water bodies by nonpoint source pollution. Education is a critical aspect of managing nonpoint source pollution. Public outreach and technology transfer are integral components of every watershed protection plan, TMDL, and implementation plan. This section highlights some of the nonpoint source education and public outreach activities conducted in fiscal year 2016.

Texas Well Owner Network

The Texas Well Owner Network (TWON) is an educational training program developed by the Texas A&M AgriLife Extension Service in the Departments of Soil & Crop Sciences and Biological & Agricultural Engineering in partnership with the Texas Water Resources Institute (TWRI). Funded by the TSSWCB under CWA Section 319(h), TWON educates well owners about water quality BMPs to protect their wells and surface waters from contaminants. Public drinking water supplies are monitored through requirements of the federal Safe Drinking Water Act. However, private well owners are responsible for monitoring the quality of their wells and are therefore at a greater risk for exposure to compromised water quality. Bacteria is the most common contaminant in private water wells in Texas, as well as the most frequent cause of water quality impairments.

TWON works with other project partners to support watershed protection planning and implementation efforts.

There are more than one million private water wells in Texas that provide water to citizens in rural areas and increasingly, to those living on small acreages in the rural-urban interface. TWON training is delivered via "Well Educated," a four-six hour course, and "Well Informed," an hour-long presentation. The "Well Educated" training course covers aquifers, household wells, improving and protecting water resources, groundwater resources, septic system maintenance, well maintenance and construction, water quality, and water treatment. The "Well Informed" presentation focuses on wellhead protection and recommendations for remediating well contamination. Through both programs, well owners can bring in water samples to test for fecal coliform bacteria, nitrate-nitrogen, and salinity.

In fiscal year 2016, ten "Well Educated" and eight "Well Informed" training events were conducted. This resulted in educating more than 400 private water well owners, and the screening of more than 740 water samples. Results from pre-test and post-test evaluations indicate that knowledge was increased for the participants. On average, participants increased their program test scores from 52% pre-program to 82% post-program. Most participants indicated that they were satisfied with the trainings, and more than 80% of participants intend to adopt behavioral changes. Furthermore, results from six-month follow-up evaluations indicated that 90% of well owners needing to remove hazardous material from their well house complied. For participants whose septic tanks needed pumping, 54% had pumped their septic tanks within six months following the program, with an additional 30% planning to pump out their system. Also, 76% of participants said they had shared TWON educational materials with other well owners.

Geronimo and Alligator Creeks Watershed Protection Plan Implementation and the Seguin Outdoor Learning Center

The Guadalupe-Blanco River Authority received CWA Section 319(h) funding from the TCEQ to work with the Irma Lewis Seguin Outdoor Learning Center to install BMPs and engage local school groups.

In fiscal year 2016, a rainwater harvesting system capable of capturing 5,000 gallons of runoff was installed on the Seguin Outdoor Learning Center's outdoor pavilion. The captured rainwater is used to irrigate the center's garden and turf grass demonstration plots. A training on rainwater harvesting was held at the center with 40 attendees.

School groups throughout the Geronimo Creek watershed were also provided opportunities to explore the riparian system of Geronimo Creek through educational activities on the Riparian Trail. Signage for plants and the identification of the three parts of a riparian system (uplands, riparian zone, and stream) were installed along the Riparian Trail. The location of signs allowed students to learn riparian terminology on the way to the creek, where they could gather and identify macroinvertebrates. Over 600 students (grades 5-12) participated in the Riparian Trail activities. School groups also rotated through 40 minute educational sessions. Elementary and high school students were administered verbal polls at the beginning and end of each of the sessions to measure the knowledge students gained. High school students completed a written assessment.

In fiscal year 2016, an interactive computer program about riparian systems was developed for the Seguin Outdoor Learning Center. In 2017, students will be able to use the program to learn about riparian systems on laptops purchased with CWA Section 319(h) funding from the TCEQ, and then explore the Riparian Trail to see a live riparian system. The program will be marketed to school districts in nearby counties, and implemented in the upcoming school year. Additional LID features are also scheduled to be installed, including pervious parking spaces and a rain garden to improve stormwater quality, reduce runoff volumes, and facilitate infiltration of water. Workshops sponsored by the Geronimo and Alligator Creeks Watershed Coordinator will be held to educate citizens on how rainwater harvesting, pervious pavement, and rain gardens affect water quality. Find more information about programs and events at the Seguin Outdoor Learning Center at http://www.seguinolc.org/.

Rainwater harvesting system located at the Irma Lewis Seguin Outdoor Learning Center *(Source: Guadalupe-Blanco River Authority)*

Texas Watershed Stewards

Over the past six years, Texas A&M AgriLife Extension Service has received state nonpoint source and CWA Section 319(h) grant funding from the TSSWCB to sponsor the Texas Watershed Stewards program. Texas Watershed Stewards is a one-day training program designed to increase citizen understanding of watershed processes and foster increased local participation in watershed management and watershed

protection planning activities across the state. The program is tailored to, and delivered in, target watersheds including TMDL or watershed protection plan activities.

During fiscal year 2016, 11 workshops were conducted in watersheds across the state with a total of 455 attendees. Participants were comprised of landowners, agricultural producers, city personnel and officials, business owners, state and federal environmental agency staff, public schools and universities, environmental and engineering professionals, and other watershed residents. Since the start of the program in 2007, 82 workshops have been conducted with a total of 3,633 attendees.

Texas Watersheds Stewards *(Source: Michael Kuitu, Texas A&M AgriLife Extension)*

Pre- and post-test data was collected at each event to determine knowledge gained by workshop attendees with a 34% increase in knowledge reported. Ninety-eight percent of attendees reported the program enabled them to be a better steward of their watershed. Results of six-month follow-up evaluations showed 83% of respondents had participated or planned to participate in at least one community cleanup, 41% participated in local planning or zoning decisions, and 56% indicated they had communicated with their elected officials regarding water quality issues. Furthermore, 90% of respondents reported they now more closely monitor individual actions that might impact water quality, and 83% have either adopted or maintained management practices that have a positive impact on water quality.

Statewide Riparian and Stream Ecosystem Education Program

TWRI, a part of Texas A&M AgriLife, received CWA Section 319(h) funding from the TSSWCB to partner with the Texas Riparian Association, Texas A&M Forest Service, Texas Parks and Wildlife Department, NRCS, NRA, and the Texas Tech University Llano River Field Station to conduct Riparian and Stream Ecosystem Education programs across the state. Riparian degradation is a major threat to water quality, instream habitat, terrestrial wildlife, aquatic species, and overall stream health.

To improve the management of these sensitive and vital ecosystems across Texas, a riparian education program was developed so landowners and land managers can understand the nature and function of riparian zones, the benefits and services they provide, and management measures used to protect them. This program has a website with online tools and education modules (<http://texasriparian.org/> and <http://naturalresourcestraining.tamu.edu/courses/texas-riparian/>), a listserv with over 321 members, and a Facebook page with 816 followers. The program website has had over 6,700 visitors since the start of the program.

Workshops are being conducted in watersheds where watershed protection plans and TMDL efforts are ongoing. In fiscal year 2016, trainings and workshops were conducted in the following watersheds: San Gabriel, Attoyac Bayou, Lampasas River, Lavaca River, Big Cypress Creek, Gilleland Creek, and Lake Arlington/Village Creek. A total of 395 people have participated in seven workshops. Course evaluations from 324 of the participants, a 93% response rate, showed that 99% of the respondents were mostly satisfied or completely satisfied with the program and the course material, 100% of the respondents would recommend the program, and 95% said they plan to adopt BMPs discussed during the workshop. Forty-three percent of respondents said they believed they might benefit economically from this program in the future. All management practices discussed received above 60% rates for "plan to adopt" by respondents. Specifically, reducing bare ground, feral hog management, and forest/herbaceous riparian buffers were a few of the BMPs that received an 80% or higher "plan to adopt" rating. Evaluation responses included 199 people who owned or managed land that totaled more than 307,247 acres. A majority of those people own small land acreages of less than 100 acres.

In June 2016, the TWRI co-chaired the planning committee with Resource Institute, Texas Riparian Association, Texas Parks and Wildlife Department, and Texas A&M Forest Service, and co-sponsored the third Southwest Stream Restoration Conference in San Antonio. The conference included three workshops, opening and closing plenary speakers, and a panel on Urban Stream Restoration. Forty-eight presentations were given during concurrent sessions on stream and riparian issues with over 180 attendees over the three days of the conference.

Texas A&M Forest Service

The Texas Silvicultural Best Management Practice Education and Implementation Project, administered by Texas A&M Forest Service through a CWA Section 319(h) grant from the TSSWCB, mitigates silvicultural nonpoint source pollution. The sustained success this program has achieved is directly related to the extensive education, outreach and technical assistance provided by the staff implementing this project. During fiscal year 2016, Texas A&M Forest Service personnel coordinated landowner workshops, contractor training sessions, professional seminars, public outreach and other educational events, reaching over 5,000 people with the message of sustainable forestry, BMPs and water quality protection.

The effectiveness of this program is primarily measured through BMP implementation monitoring. Results from the most recent round of monitoring indicate a 94% implementation rate. Based on this rate, computer models predict annual sediment load reductions from 747,525 acres of East Texas forestlands to be 92,000 tons, 12,000 tons of which would otherwise enter our streams, lakes, and rivers.

Maintaining a proactive approach to addressing water quality issues is one of the foundations of this project. In fiscal year 2016, a smartphone application of the *Texas Forestry Best Management Practices Handbook* (May 2014) was released for both iOS and Android operating systems. Users have quick, easy, and searchable access to the Texas forestry BMP guidelines, along with new digital tools, such as a clinometer to measure slope and a location tool to identify the soil series and properties at a specific location.

While this project historically has focused efforts in East Texas, new attention has been given to water resource protection throughout the state. Urban forests are an important factor of green infrastructure because they reduce stormwater runoff and improve water quality. Texas A&M Forest Service used the iTree software and found a 1% increase in urban forest canopy in Houston can reduce stormwater runoff by 2.2 million gallons. This reduction can improve water quality and also increase the effectiveness of existing stormwater BMPs. Texas A&M Forest Service personnel are sharing this information with stormwater managers and planners to quantitatively justify the use of urban forests as the initial treatment in a stormwater management plan.

Coordinating project efforts is critical to building cooperation, enhancing outcomes, and achieving results. Project personnel routinely meet with critical stakeholder groups to share information and identify opportunities for collaboration. As a result of these relationships, Texas A&M Forest Service recently established the *Texas Forests and Drinking Water Partnership*. This initiative seeks to increase awareness of and communication between the forest and water sectors because these natural resources are interdependent. The partnership has met twice, and has generated momentum for practicing sustainable forestry, implementing BMPs, mitigating nonpoint source pollution, and protecting drinking water sources.

Low Impact Development Education in the Lower Rio Grande Valley

Texas A&M University-Kingsville received CWA Section 319(h) funding from the TCEQ to work with cities in the Lower Rio Grande Valley to implement and institutionalize LID in the region. An extensive outreach and education campaign on the concepts, techniques and benefits of LID was launched in 2011 to target a wide variety of audiences.

In fiscal year 2016, ten webinars were held for municipal stormwater professionals, engineers, and planners that focused on nonpoint source pollution and LID with a total of 136 attendees. A short documentary about LID was created for the general public, as well as stormwater professionals, engineers, and students. It aired three times in fiscal year 2016 at a summer engineering camp and college engineering course, reaching a total of 35 individuals. Nineteen weekly sessions for nine engineering students were held during the fall and spring semesters at South Texas College. The sessions included presentations on topics relating to LID, including operation and maintenance of LID features, water quality concepts, and fundamentals of water quality monitoring. Staff from Texas A&M University-Kingsville also gave presentations at four events throughout the region to professional organizations, stormwater professionals, municipal parks staff, and the general public, with a total of 73 attendees. In addition to presentations, special events were held for stormwater professionals and high school students, including live LID BMP demonstrations and site visits. Texas A&M-Kingsville staff presented at the South Padre Institute Conference, where over 160 students and 124 professionals were in attendance. Other efforts included distributing 450 educational brochures in English and Spanish at the Earth Day festival in Edinburg, Texas; and the Rio Grande Valley's Engineering Summer Camp, where sixteen students learned the importance of LID alongside other engineering concepts. In fiscal year 2016, Texas A&M University-Kingsville staff hosted or attended over 37 events where more than 750 people learned about LID and nonpoint source pollution.

The outreach campaign has been successful in educating local residents, stormwater professionals, engineers, and government staff on the importance of LID. Recently, LID was integrated in local ordinances and municipal codes in the cities of Edinburg and Weslaco. Local engineers and developers have also implemented LID BMPs in projects throughout the region. For example, in McAllen a local developer used LID BMPs to improve water quality while maximizing parking availability at South Texas College. The outreach campaign will continue to be a useful tool as the region grows and adapts with LID concepts.

Developing and Implementing Watershed Protection Plans

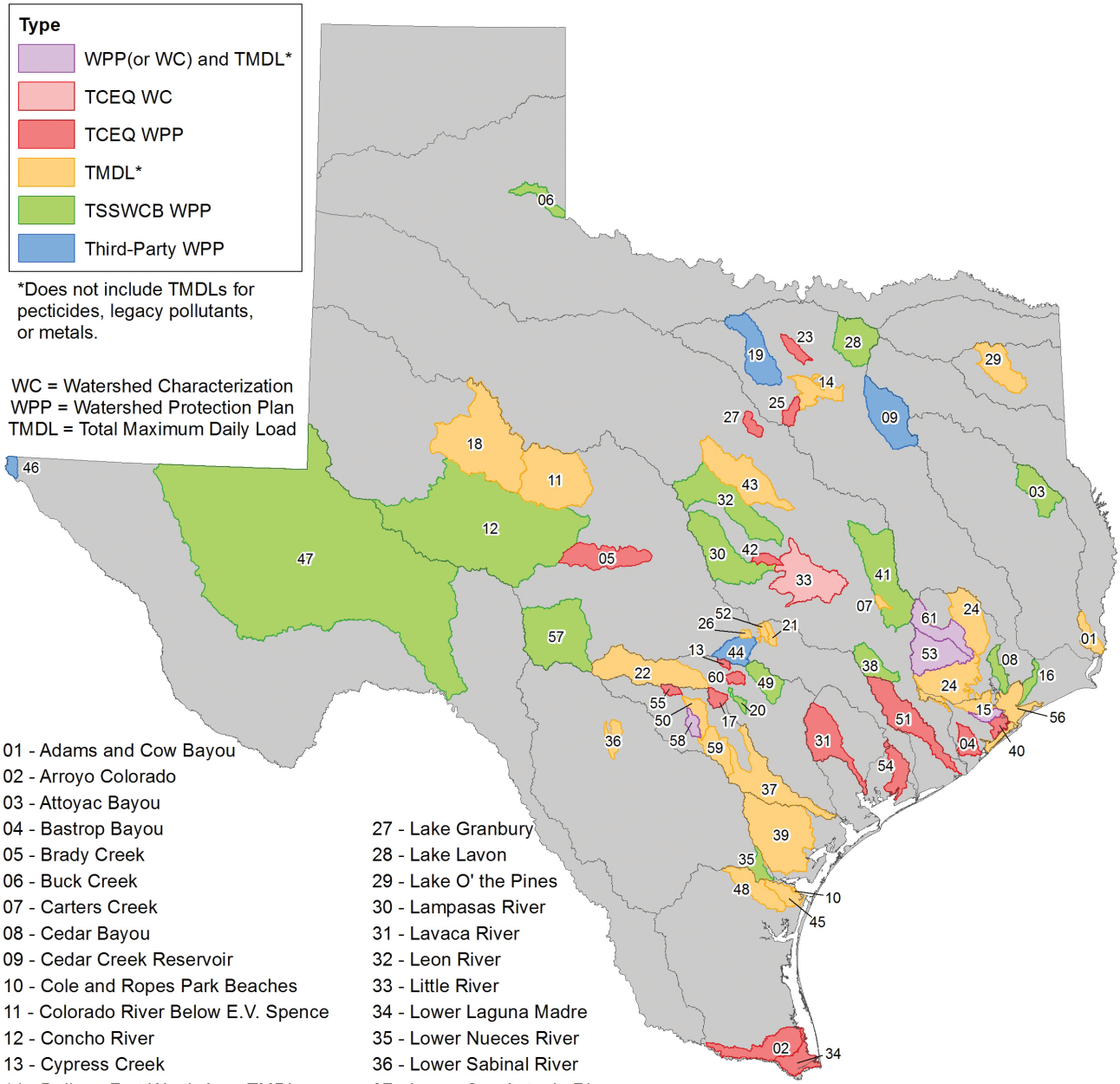
Pedernales Falls *(Source:Thinkstock)*

The TCEQ and the TSSWCB apply the Watershed Approach to managing nonpoint source pollution by supporting the development and implementation of watershed protection plans. These plans are developed through local stakeholder groups who coordinate activities and resources to manage water quality. In Texas, watershed protection plans facilitate the restoration of impaired water bodies and the protection of threatened waters before they become impaired. These stakeholder-driven plans give the decision-making power to the local groups most vested in the goals specified in the plans. Bringing groups of people together through watershed planning efforts combines scientific and regulatory water quality factors with social and economic considerations. While watershed protection plans can take many forms, the development of plans funded by CWA Section 319(h) grants must follow guidelines issued by the EPA. These guidelines can be found in the *Nonpoint Source Program and Grants Guidelines for States and Territories*, <http://water.epa.gov/polwaste/nonpoint source/upload/319-guidelines-fy14.pdf>.

In fiscal year 2016, the TCEQ and the TSSWCB facilitated the development and implementation of 37 watershed protection plans throughout Texas by providing technical assistance and/or funding through grants to regional and local planning agencies and, thereby, to local stakeholder groups. A significant portion of the funding to address nonpoint source pollution under the federal CWA is dedicated to the development and implementation of watershed protection plans in areas where nonpoint source pollution has contributed to the impairment of water quality. In Texas, watershed protection plans are also developed by third parties independent from the TSSWCB and the TCEQ. Figure 4.1 is a map of watershed protection plans and TMDL implementation plans being developed or implemented in Texas at the end of fiscal year 2016. Table 4.1 is a list of the same plans and links to more information. Neither the map nor table is intended to be a comprehensive list of all the watershed planning efforts currently underway in Texas.

Pedernales Falls *(Source:Thinkstock)*

Figure 4.1 Map of Watersheds with Watershed Protection Plans (WPP), Watershed Characterization (WC), or TMDL Implementation Plans Being Developed or Implemented



01 - Adams and Cow Bayou
02 - Arroyo Colorado
03 - Attoyac Bayou
04 - Bastrop Bayou
05 - Brady Creek
06 - Buck Creek
07 - Carters Creek
08 - Cedar Bayou
09 - Cedar Creek Reservoir
10 - Cole and Ropes Park Beaches
11 - Colorado River Below E.V. Spence
12 - Concho River
13 - Cypress Creek
14 - Dallas - Fort Worth Area TMDLs
15 - Dickinson Bayou
16 - Double Bayou
17 - Dry Comal/Comal
18 - E.V. Spence Reservoir
19 - Eagle Mountain Reservoir
20 - Geronimo Creek
21 - Gilleland Creek
22 - Guadalupe River Above Canyon Lake
23 - Hickory Creek
24 - Houston Area TMDLs
25 - Lake Arlington and Village Creek
26 - Lake Austin
27 - Lake Granbury
28 - Lake Lavon
29 - Lake O' the Pines
30 - Lampasas River
31 - Lavaca River
32 - Leon River
33 - Little River
34 - Lower Laguna Madre
35 - Lower Nueces River
36 - Lower Sabinal River
37 - Lower San Antonio River
38 - Mill Creek
39 - Mission and Aransas
40 - Moses-Karankawa Bayous
41 - Navasota Below Lake Limestone
42 - Nolan Creek
43 - North Bosque River
44 - Onion & Barton Creeks
45 - Oso Bay and Oso Creek
46 - Paso del Norte
47 - Pecos River
48 - Petronila Creek
49 - Plum Creek
50 - Salado Creek
51 - San Bernard
52 - Spicewood Springs and Walnut Creek
53 - Spring and Cypress Creek
54 - Tres Palacios
55 - Upper Cibolo Creek
56 - Upper Coast Oyster Waters
57 - Upper Llano River
58 - Upper San Antonio River
59 - Upper San Antonio River
60 - Upper San Marcos
61 - West Fork San Jacinto and Lake Creek

Table 4.1 Watershed Protection Plans Being Implemented or Under Development in Texas

TSSWCB WPPs	Links
Attoyac Bayou	http://attoyac.tamu.edu/
Buck Creek	http://buckcreek.tamu.edu/
Cedar Bayou	http://www.cedarbayouwatershed.com/
Concho River	http://www.tsswcb.texas.gov/managementprogram/conchowpp
Double Bayou	http://www.doublebayou.org/
Geronimo Creek	http://www.geronimocreek.org/
Lake Lavon	https://www.ntmwd.com/watershed-management/
Lampasas River	http://www.lampasasriver.org/
Leon River	http://leonriver.tamu.edu/
Lower Nueces River	http://www.nuecesriverpartnership.org/
Mill Creek	http://millcreek.tamu.edu/
Navasota River	http://navasota.tamu.edu/
Pecos River	http://pecosbasin.tamu.edu/
Plum Creek	http://www.plumcreek.tamu.edu/
Upper Llano River	http://www.llanoriver.org/
TCEQ WPPs	**Links**
Arroyo Colorado	http://www.arroyocolorado.org/watershed-protection-plan/
Bastrop Bayou	http://www.bastropbayou.org/
Brady Creek	http://www.ucratx.org/brady.html
Cypress Creek	Under Development
Dry Comal/Comal River	http://www.nbtexas.org/1914/Watershed-Protection-Planning
Hickory Creek	https://www.cityofdenton.com/residents/make-a-difference/sustainability/watershed-protection
Highland Bayou & Moses-Karankawa Bayous	http://www.agrilife.org/highlandbayou/
Lake Arlington/Village Creek	http://www.trinityra.org/lakearlingtonvillagecreek
Lake Granbury	http://www.lakegranburywatershed.org/
Lower Laguna Madre/Brownsville Ship Channel	http://www.arroyocolorado.org/lower-laguna-madrebrownsville-ship-channel-watershed/
Nolan Creek	http://www.nolancreekwpp.com
San Bernard River	http://www.h-gac.com/community/water/watershed_protection/san-bernard-river.aspx
Tres Palacios Creek	http://matagordabasin.tamu.edu/
Upper Cibolo Creek	http://www.ci.boerne.tx.us/147/Upper-Cibolo-Creek-Watershed
Upper San Antonio River	http://www.bexarfloodfacts.org/watershed_protection_plan/
Upper San Marcos River	http://www.smwatershedinitiative.org/
West Fork of San Jacinto	http://www.westfork.weebly.com/
TCEQ Watershed Characterizations	**Links**
Cypress Creek (San Jacinto River Basin)	http://www.westfork.weebly.com//
Little River	http://littleriver.tamu.edu/
Spring Creek	http://westfork.weebly.com/
Bridge Documents (Accepted by EPA as WPPs)	**Links**
Colorado River Below EV Spence Reservoir	www.tceq.texas.gov/waterquality/nonpoint-source/mgmt-plan/watershed-pp.html
Dickinson Bayou	http://www.h-gac.com/community/water/watershed_protection/default.aspx
Third-Party WPPs	**Links**
Cedar Creek Reservoir	http://nctx-water.tamu.edu/media/1475/ccwpp.pdf
Eagle Mountain Reservoir	http://nctx-water.tamu.edu/meetings
Onion Creek and Barton Springs	http:/www.waterqualityplan.org/
Paso del Norte	http://www.pdnwc.org/319h.html

Watershed Protection Plan Highlights

Mill Creek

Mill Creek is formed where two branches, the East and West Forks of Mill Creek, unite near Bellville, Texas in Austin County. Mill Creek then flows 14 miles southeast to its confluence with the Brazos River. A Recreational Use Attainability Analysis conducted on Mill Creek in 2007 confirmed that primary contact recreation use is the correct water quality standard for Mill Creek. In 2010, Mill Creek was added to the 303(d) list as impaired due to elevated levels of bacteria.

In 2014, Texas A&M AgriLife Extension received a state nonpoint source grant from the TSSWCB to work with stakeholders to develop a watershed protection plan for Mill Creek. The goal of this project was to establish a comprehensive plan to address bacteria pollution and other potential sources of pollution in the watershed.

The first meeting of the Mill Creek Watershed Partnership and Steering Committee was held in January 2015, which marked the beginning of the stakeholder-driven watershed protection plan development process. Development meetings were held over the following six months and the Mill Creek Watershed Protection Plan was submitted to the EPA in July of 2015. EPA provided comments in October 2015. The plan was revised in response to EPA's comments and changes were approved by the Mill Creek Watershed Partnership and Steering Committee. The revised watershed protection plan was formally accepted by EPA in February 2016.

Education and Outreach Activities

A few years prior to the development of the Mill Creek Watershed Protection Plan, local stakeholders organized and conducted a forum to address regional water issues. This event, known as the Lone Star Water Forum, has historically focused on water supply and water conservation issues in the region. However, due to the awareness generated by the Mill Creek Watershed Protection Plan development process, organizers intend to incorporate new educational opportunities as part of the forum pertaining to the impact of BMPs on water quality.

A Texas Watershed Steward workshop was held in January 2015 before the first watershed protection plan development meeting. The Texas Watershed Steward program is a statewide one-day or half-day educational program designed to improve the quality of Texas' water resources by educating and informing local stakeholders about their watershed, potential impairments, and ways to improve and protect water quality.

In June 2016, Texas A&M AgriLife Extension presented a program in Austin County to educate homeowners on how to properly maintain septic systems. The topics covered included a history of septic systems in Texas, common types of systems, maintenance items, when to have a system pumped, and what not to dispose of down the drain. As outlined in the Mill Creek Watershed Protection Plan, counties in the watershed intend to work with AgriLife Extension to conduct annual septic system trainings. Additionally, counties in the watershed will allow homeowners to forego the septic system maintenance contract requirement and maintain their own system provided the homeowner completes an approved septic system training course.

Watershed Implementation Activities

Soon after the completion of the Mill Creek Watershed Protection Plan, AgriLife Extension submitted a proposal to the TSSWCB for CWA Section 319(h) funding to support implementation and employ a full-time watershed coordinator. The watershed coordinator will continue to facilitate the Mill Creek Watershed Partnership, lead implementation efforts, engage with stakeholders, and maintain a high awareness and involvement by conducting outreach and educational events. Furthermore, the watershed coordinator will work to identify and build support for local funding to support implementation activities.

The Austin and Washington County SWCDs submitted a proposal for CWA Section 319(h) funding from the TSSWCB to employ a full-time technician to provide resources and technical assistance in the watershed. A primary function of this new position will be to work with stakeholders to develop and implement WQMPs. These plans strategize the placement of agricultural BMPs and provide an opportunity for landowners to receive financial assistance to support implementation.

For more information on the Mill Creek Watershed Protection Plan and implementation activities visit <http://millcreek.tamu.edu/>.

Bastrop Bayou

Meandering through coastal prairie, wetlands, and small urban centers, Bastrop Bayou drains part of coastal Brazoria County. In 2004, the GBEP and the Houston-Galveston Area Council (H-GAC) conducted a Watershed Risk Assessment which raised concerns about the future of Bastrop Bayou due to rapid development and changes in land use. The combined impacts of agricultural operations, urban stormwater, failing septic systems, feral hogs, and pet waste were threatening the bayou's ability to support contact recreation uses. Concerned about these impacts, local stakeholders formed the Stakeholder Advisory Group in 2004 and began to work with TCEQ and the H-GAC to develop a watershed protection plan for Bastrop Bayou. There were no impairments in Bastrop Bayou or its tributaries in 2004; however by 2014, there were impairments for bacteria in Bastrop Bayou and four of its tributaries, and a low dissolved oxygen impairment in Brushy Bayou, a tributary of Bastrop Bayou.

Development of the watershed protection plan presented several challenges, including the modeling of bacteria loads in a system including both tidal and non-tidal streams. Because of

Local stakeholder in the Bastrop Bayou watershed *(Source: H-GAC)*

rapid population growth and land use changes in the watershed, the watershed protection plan based its load reduction goals on projected increases in sources of pollutant loads, rather than the more common approach of planning how to reduce current pollutant loads. The TCEQ supported additional modeling and plan revisions between 2008 and 2014. TCEQ accepted a revised plan in June 2016 and submitted it to EPA. After minor revisions, EPA accepted the plan in July 2016.

Watershed Implementation Activities

Over the years as the watershed protection plan was under development, H-GAC and TCEQ initiated several implementation projects. This included a wide range of BMPs and a robust education and outreach effort, discussed below. The most recent project supported activities to address key bacteria sources from agriculture, urban stormwater, septic systems, pets, and feral hogs, as well as the continued revision of the watershed protection plan. The outreach efforts included feral hog workshops, septic system inspection training, workshops for agricultural producers, school educational visits in Angleton Independent School district by H-GAC staff, and informational booths at local events. Structural implementation efforts included installation and maintenance of pet waste stations in public areas, decommissioning of failing septic systems, and Trash Bash® events held annually. Trash Bash® is a volunteer-based waterway cleanup event organized by the Texas Conservation Fund, H-GAC, and a coordination committee that has been held for the past 23 years. The project also continued coordination with local partners on shared priorities, such as the decommissioning of failing septic systems in the watershed. H-GAC provided assistance to the Brazoria County Freshwater Supply District #2 in planning expansion of wastewater service with CWSRF funds from the TWDB, while TCEQ provided CWA Section 319(h) funding for the safe decommissioning of failing septic systems for those in financial need. This effort made it possible for the transition of septic systems to sanitary sewer service in the Demi John community, a low-lying waterfront area with a high rate of failing septic systems.

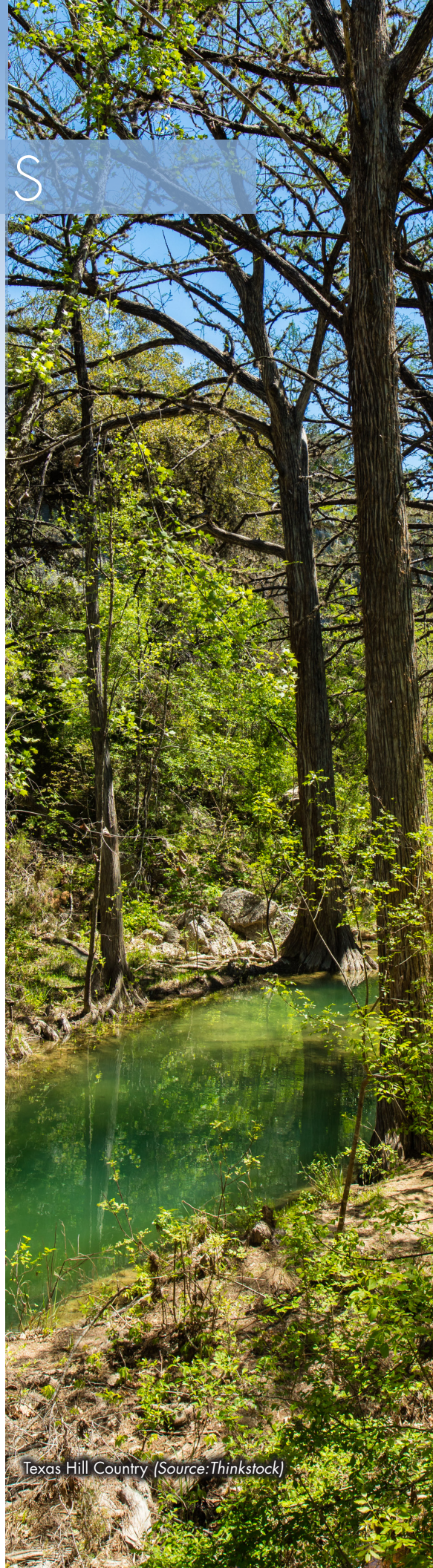
As watershed populations grow and land use shifts toward more developed areas, emerging issues include an increase in bacteria sources related to development, increased impervious cover, and added strain on aging sanitary sewer infrastructure. Short term priorities in the next five to ten years include expanded efforts to remediate failing septic systems; expansion of existing agricultural management measures by the TSSWCB, Texas A&M Agrilife, and USDA NRCS; and continued education and outreach in support of pollution reduction for all of the priority sources. Longer term efforts in the coming decades include evaluating the impact of short term activities and water quality trends by H-GAC; promoting the use of LID in new development by Brazoria County; and addressing increased pet populations in urban areas with expanded pet waste facilities by Brazoria County and cities within the county.

For more information on the Bastrop Bayou watershed and implementation activities, please visit <http://www.bastropbayou.org/>.

Debris removed from Bastrop Bayou *(Source: H-GAC)*

ABBREVIATIONS

AU	Assessment Unit
BMP	Best Management Practice
CAMS	Continuous Ambient Monitoring System
CBBEP	TCEQ Coastal Bend and Bays Estuary Program
cfu/100mL	colony forming units per 100 milliliters
CMP	Texas Coastal Management Program
CWA	Clean Water Act
CWQMN	TCEQ Continuous Water Quality Monitoring Network
CWSRF	Clean Water State Revolving Fund
CZARA	Coastal Zone Act Reauthorization Amendment
E. coli	*Escherichia coli*
EPA	U.S. Environmental Protection Agency
GBEP	TCEQ Galveston Bay Estuary Program
GLO	Texas General Land Office
GRTS	Grants Reporting and Tracking System
H-GAC	Houston-Galveston Area Council
Integrated Report	Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d)
lbs	Pounds
LCRA	Lower Colorado River Authority
LID	Low Impact Development
NRA	Nueces River Authority
NRCS	Natural Resources Conservation Service
SWCD	Soil and Water Conservation District
TBET	Texas Best Management Practices Evaluation Tool
TCEQ	Texas Commission on Environmental Quality
TXCNPS	Texas Coastal Nonpoint Source Management Program
TGPC	Texas Groundwater Protection Committee
TMDL	Total Maximum Daily Load
TSSWCB	Texas State Soil and Water Conservation Board
TWDB	Texas Water Development Board
TWON	Texas Well Owner Network
TWRI	Texas Water Resources Institute
TxDOT	Texas Department of Transportation
UGRA	Upper Guadalupe River Authority
WAP	Watershed Action Planning
WC	Watershed Characterization
WPP	Watershed Protection Plan
WQMP	Water Quality Management Plan



Texas Hill Country *(Source: Thinkstock)*

APPENDIX

Texas Nonpoint Source Management Program Milestones

Goals / Objectives	Milestone	Milestone Description	Milestone Measurement	2016[1] Estimate	2016 Actual	Comments
ST1/A	Nonpoint Source Assessment Report	The state will produce the Integrated Report in accordance with applicable EPA guidance	Integrated Report	1	1	The EPA approved the 2014 Integrated Report on November 19, 2015 in fiscal year 2016.
LT/2	Nonpoint Source Management Program Updates	The state will update the Management Program in accordance with applicable EPA guidance	Management Program updates	0	0	Next update due in 2017
LT/7	Nonpoint Source Annual Report	The state will produce the Nonpoint Source Annual Report in accordance with applicable EPA guidance	Nonpoint Source Annual Report	1	1	January 2017
LT/2-5	Section 319(h) Grant Program Solicitation	The state will conduct individual TCEQ and TSSWCB solicitations for Section 319(h) grant funding	Grant Solicitation documentation	2	2	One from each agency
LT/2-5	Section 319(h) Grant Program Application	The state will prepare individual TCEQ and TSSWCB grant program applications and submit them to EPA for Section 319(h) grant funding	Grant Application documentation	2	2	One from each agency
LT/2	Section 319(h) Grant Program Reporting	The state will report grant funded activities to the Grants Reporting and Tracking System (GRTS) in accordance with EPA guidance	GRTS updates	4	4	Two from each agency

continued on next page

Appendix: **Texas Nonpoint Source Management Program Milestones** *(cont'd)*

Goals / Objectives	Milestone	Milestone Description	Milestone Measurement	2016[1] Estimate	2016 Actual	Comments
ST2/A	Priority Watersheds Report Updates	The state will update the Priority Watersheds Report based upon information and recommendations derived through the WAP process as described in the Management Program	Priority Watersheds Report Updates	0	0	Next update due in 2017
ST3/C,D	Watershed Training	The state will provide training to watershed professionals to ensure quality and consistency in the development and implementation of watershed protection efforts	Texas Watershed Planning Short Course	1	1	
ST3/A,B,F,G	Watershed Education	The state will provide watershed education to help citizens participate in programs designed to address water quality issues	Texas Watershed Steward Program (number of workshops)	10	11	
ST3/C,D	Watershed Training	The state will provide a forum to facilitate the transfer of information between watershed professionals in the state	Texas Watershed Coordinator Roundtable	2	2	
ST3/B,F,G	Volunteer Monitoring	The state will provide support for local volunteer monitoring groups. These groups provide water quality data to the state water quality planning program and gain insight into resolving water quality issues	Texas Stream Team Participation (numbers of stations/sites monitored)	250	580	From Texas Stream Team annual report
ST3/C,F,G	Urban BMPs	The state will provide technical and financial assistance to local communities to support the implementation of urban BMPs	Coastal Urban BMP Guidance Manual	0	0	

continued on next page

Appendix: **Texas Nonpoint Source Management Program Milestones** *(cont'd)*

Goals / Objectives	Milestone	Milestone Description	Milestone Measurement	2016[1] Estimate	2016 Actual	Comments
ST1/B	Quality Assurance	The state will ensure that monitoring procedures are in compliance with EPA-approved TCEQ and TSSWCB Quality Management Plans	Annual Quality Management Plan Updates	2	2	
ST1/C	Watershed Characterization	The state will support the implementation of projects designed to evaluate watershed characteristics and produce the information needed for watershed and water quality models	Watershed Characterization Projects	0	6	
ST2/A,C	Watershed Coordination	The state will support watershed coordination projects which facilitate the implementation of WPPs	Watershed Coordination Projects	1	17	
ST1/D	Develop WPPs	The state will support projects which provide for the development of WPPs which satisfy applicable EPA guidance	WPP Development Projects	2	17	
ST2/D	Implement WPPs	The state will support projects which provide for the implementation of management measures specified in WPPs which satisfy applicable EPA guidance	WPP Implementation Projects	2	31	
ST1/D	Develop TMDLs and implementation plans	The state will support projects which provide for the development of TMDLs and implementation plans which satisfy applicable state, federal, and program regulations and guidance	TMDL and Implementation Plan Development Projects	0	0	

continued on next page

Appendix: **Texas Nonpoint Source Management Program Milestones** *(cont'd)*

Goals / Objectives	Milestone	Milestone Description	Milestone Measurement	2016[1] Estimate	2016 Actual	Comments
ST2/D	Implement TMDLs and implementation plans	The state will support projects which provide for the implementation of management measures specified in TMDLs and implementation plans which satisfy applicable state, federal, and program regulations and guidance	TMDL Implementation Plan Implementation Projects	1	7	
ST2/B,C	Load Reductions (Nitrogen)	The state will ensure project reductions are reported utilizing GRTS	GRTS Report	RQ[2]	118,210 lbs/yr	Numbers reflect projects with load reductions reported in FY16
ST2/B,C	Load Reductions (Phosphorus)	The state will ensure project reductions are reported utilizing GRTS	GRTS Report	RQ[2]	14,084 lbs/yr	Numbers reflect projects with load reductions reported in FY16
ST2/B,C	Load Reductions (Sediment)	The state will ensure project reductions are reported utilizing GRTS	GRTS Report	RQ[2]	7,807 tons/yr	Numbers reflect projects with load reductions reported in FY16
ST2/E	Effectiveness Monitoring	The state will support projects which provide for the collection and analysis of water quality and other watershed information for the purpose of evaluating the effectiveness of BMPs	Effectiveness Monitoring Projects	3	12	Numbers reflect active projects

[1] Estimates are from the 2012 Texas Nonpoint Source Management Program report
[2] RQ – Reportable Quantity

Neches River *(Source: Angelina Neches River Authority)*

Red-eared Slider *(Source:*

Tricolored Heron *(Source: Jason Leifester, TCEQ)*

(Source: Texas A&M Forest Service Hughes Simpson)

Lake Sam Rayburn *(Source: Angelina Neches River Authority)*

Brays Bayou *(Source: H-GAC)*

www.tceq.texas.gov/publicatons/sfr/sfr-066-16.html

Printed on recycled paper using vegetable-based ink.

How is our customer service?
Fill out our online customer-satisfaction survey at **www.tceq.texas.gov/customersurvey**

The TCEQ is an equal opportunity employer. The agency does not allow discrimination on the basis of race, color, religion, national origin, sex, disability, age, sexual orientation, or veteran status. In compliance with the Americans with Disabilities Act, this document may be requested in alternate formats by contacting the TCEQ at 512-239-0010, or 1-800-RELAY-TX (TDD), or by writing P.O. Box 13087, Austin, TX 78711-3087.