

NOLAN CREEK

Watershed Action Plan for the Nolan Creek/South Nolan Creek Watershed



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While taking full responsibility for the information presented herein, we would like to thank those involved with previous Texas Watershed Protection Plans (WPPs). These previous WPPs provided guidance for much of the information regarding management measures for bacteria impairments and available technical and financial resources. The WPPs for the Leon River below Proctor Lake and above Belton Lake (Parson Water & Infrastructure, Inc. and the Brazos River Authority, 2015) and the Lampasas River (Prcin and Srinivasan, 2013) were important resources, as the Leon and Lampasas River watersheds border the Nolan Creek/South Nolan Creek watershed. The Lampasas and Leon WPPs provided relevant information from the surrounding area and a continuity in the planning process where various municipal, county, and other stakeholder boundaries stretch across all three watersheds.

For more information about this document or any other documents TIAER produces, email info@tiaer.tarleton.edu. More information about the Nolan Creek/South Nolan Creek project can be accessed from the project website at: <http://www.nolancreekwpp.com/>.

Cover photograph is South Nolan Creek at Farm-to-Market 3219 (station 11911) taken on November 8, 2017.

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List of Acronyms

AU	Assessment Unit
AWCL	Agricultural Water Conservation Loan
BCHD	Bell County Health Department
BMP	Best Management Practice
BPAC	Bicycle and Pedestrian Advisory Committee
BRA	Brazos River Authority
CAFO	Concentrated Animal Feeding Operation
CCN	Certificates of Convenience and Necessity
CDBG	Community Development Block Grant
cfu	colony forming unit
CIG	Conservation Innovation Grants
CRP	Clean Rivers Program
CSP	Conservation Stewardship Program
CTCOG	Central Texas Council of Governments
CWA	Clean Water Act
CWSRF	Clean Water State Revolving Fund
DFAC	Dining Facilities Administration Center
<i>E. coli</i>	<i>Escherichia coli</i>
EDAP	Economically Distressed Area Program
EE	Environmental Education
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
F&RLCP	Farm & Ranch Lands Conservation Program
FOG	fats, oils, and grease
HHW	household hazardous waste
HUD	Housing and Urban Development
HHS	Health and Human Services
IDDE	illicit discharge detection and elimination
KTMPO	Killeen-Temple Metropolitan Planning Organization
LID	low impact development
LIP	Landowner Incentive Program
LSHS	Lone Star Healthy Streams
MGD	million gallons per day
MPN	most probable number
MS4	Municipal Separate Storm Sewer System
MST	Microbial Source Tracking
NRCS	Natural Resource Conservation Service
OSSF	on-site sewage facility
RTF	Recreational Trails Fund
SCS	Soil Conservation Service
SEP	Supplemental Environmental Project
SSO	sewer system overflow
STEP	Septic Tank Elimination Program
SWCD	Soil and Water Conservation District

SWMP	Stormwater Management Plan
TCEQ	Texas Commission on Environmental Quality
TDA	Texas Department of Agriculture
TFS	Texas Forest Service
TIAER	Texas Institute for Applied Environmental Research
TMDL	Total Maximum Daily Load
TPWD	Texas Parks and Wildlife Department
TSSWCB	Texas State Soil and Water Conservation Board
TV	television video
TWDB	Texas Water Development Board
TWRI	Texas Water Resources Institute
TxDOT	Texas Department of Transportation
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WAP	Watershed Action Plan
WCID	Water Control and Improvement District
WFPO	Watershed and Flood Prevention Operations
WPP	Watershed Protection Plan
WSEP	Water Supply Enhancement Program
WQMP	Water Quality Management Plan
WWTF	wastewater treatment facility

SECTION 1

Watershed Action Planning

Watershed protection plans (WPPs) are a way of holistically characterizing water quality issues, sources of impairments, and developing a plan with the goal of water quality recovery. The success of the planning process involves multiple steps and depends intensively on stakeholder involvement. Because sources of impairments are not always clear, particularly in dealing with nonpoint source pollution, local knowledge is needed to engage individuals throughout the watershed in management practices and behaviors needed for abatement success. A local stakeholder committee along with a technical advisory group, comprised what is referred to as the Nolan Creek Partnership, in defining the watershed action plan (WAP) outlined in this document.

EPA Nine Elements

To address the planning process, the Environmental Protection Agency (EPA) has outlined nine elements for a WPP (EPA, 2008). These nine elements include:

- a) Identification of impairment causes and pollutant sources that need to be controlled to achieve desired load reductions and meet water quality standards.
- b) An estimate of load reductions expected from management measures to meet desired load reductions.
- c) A description of the management measures needed to achieve desired load reductions and the critical areas where these measures should be implemented.
- d) An estimate of the technical and financial assistance needed to implement the plan.
- e) Identification of an information and education component that will be used to enhance public understanding and participation in the plan.
- f) A schedule for implementing management measures.
- g) A description of interim, measurable milestones for tracking the implementation of management measures in comparison to the developed schedule.
- h) A set of water quality criteria that can be used to determine if loading reductions are being achieved.
- i) A water quality monitoring component to evaluate effectiveness of implementation measures in restoring water quality to these established criteria.

Elements “a” and “b” have largely been addressed in a previous characterization project, full details of which can be accessed at: <http://tiaer.tarleton.edu/ruaa/nolan-creek-watershed.html>. For development of the Nolan Creek/South Nolan Creek WAP, this report focuses on Elements “c” through “g” in detailing management measures defined and prioritized by the Nolan Creek

Partnership. These management measures target bacteria as the impairment in association with recreational use of the creek. There are assessment concerns regarding nutrients and expressed concerns from stakeholders involving streambank erosion and flood management, both of which are included in this WAP.

Nolan Creek/South Nolan Creek

Impairments and Concerns

Assessment units (AUs) 1218_02 and 1218C of Nolan Creek/South Nolan Creek are listed by the Texas Commission on Environmental Quality (TCEQ) as impaired for primary contact recreation based on elevated bacteria concentrations (TCEQ, 2015a; Figure 1-1). Concerns are also noted for nitrates and total phosphorus within AU 1218_02 and for bacteria along AU 1218A (TCEQ, 2015b).

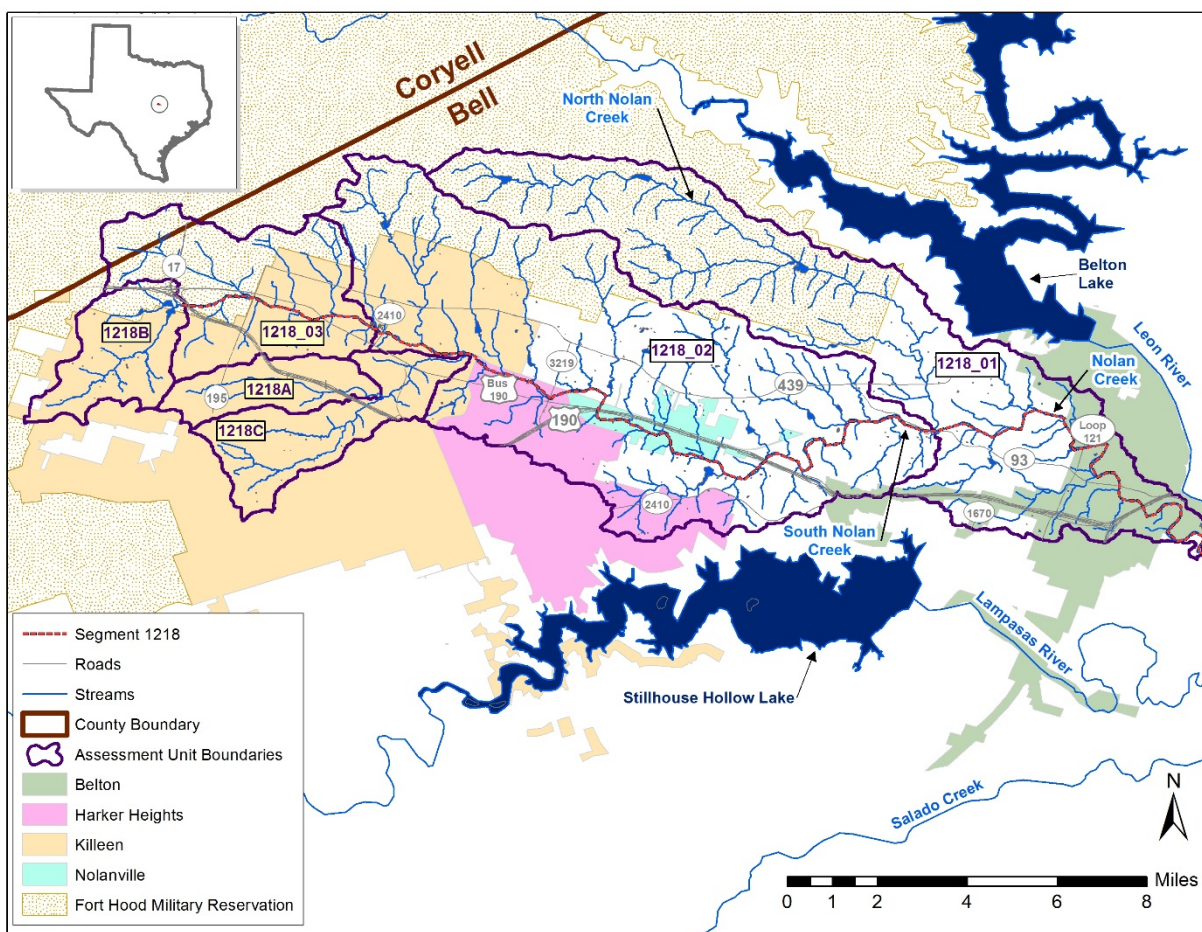


Figure 1-1 Watershed and assessment units associated with Segment 1218, Nolan Creek/South Nolan Creek. Inset shows watershed location within the State of Texas.

Until 2010, Segment 1218 was recognized as one AU and first listed as impaired for bacteria in 1996 (TCEQ, 1997). Based on more intensive monitoring conducted largely between October

2006 and February 2008 under a project lead by the City of Killeen (see Nett and Flowers, 2008), Segment 1218 was divided into three AUs 1218_01, 1218_02, and 1218_03 and three additional waterbodies (1218A, 1218B, and 1218C) were recognized for assessment purposes (TCEQ, 2011a). With this partitioning of Nolan Creek/South Nolan Creek, only AU 1218_02 and 1218C were noted as impaired for bacteria in the 2010 Texas Water Quality Assessment (TCEQ, 2011b) and both continue to be listed with the 2014 303(d) list (TCEQ, 2015a).

Sources

Major sources of bacteria and nutrients, as listed in the 2014 TCEQ Integrated Report on Surface Water Quality, come from point and nonpoint sources within the Nolan Creek/South Nolan Creek watershed (TCEQ, 2015c). Nonpoint sources listed include municipal runoff from high density, urbanized areas and on-site sewage facilities (OSSFs), often referred to as septic systems. Municipal point sources are largely related to unauthorized discharges associated with the sanitary sewer system and stormwater drainage area.

A study conducted by the City of Killeen in the upper portion of the watershed with monitoring data collected between October 2006 and February 2008 found low bacteria levels above 38th Street and confirmed elevated bacteria concentrations between Twin Creek Drive in Killeen and Ann Boulevard in Harker Heights (Nett and Flowers, 2008). Elevated bacteria were also noted along Long Branch and Little Nolan Creek, which flow largely within the City of Killeen. From this study, a positive correlation was observed between the number of septic tanks in the drainage area above sampling stations and bacteria concentrations (Nett and Flowers, 2008).

More recent monitoring conducted from May 2013 through June 2015 continued to show elevated concentrations all along Nolan Creek/South Nolan Creek from its crossing at Twin Creek Drive in Killeen to the most downstream sampling station in Yettie Polk Park in Belton (McFarland and Adams, 2015a). Of note, sampling stations upstream of Twin Creek Drive at 38th Street in Killeen and above the wastewater treatment facility (WWTF) discharge of the Bell County Water Control and Improvement District (WCID) No. 1 Main Plant generally indicated bacteria concentrations below the assessment criterion (126 cfu/100 mL for primary contact recreation). On occasion all along the creek, “spikes” in bacteria concentrations from monthly monitoring data were observed that were clearly associated with sewer system overflows (SSOs) or fish kills (McFarland and Adams, 2015a), but pinpointing specific sources for the continuous loading of bacteria to the creek appears to vary with location (McFarland and Adams, 2015b; 2015c). Highly urbanized areas include the cities of Killeen, Harker Heights, and Nolanville in the upper to mid portion of the watershed and the city of Belton in the lowermost portion (Figure 1-2). The landscape between Nolanville and Belton is largely rural and dominated by grassland and forest, used mainly for livestock grazing. These urban and rural areas provide different sources of bacteria.

Sources of bacteria in the watershed, as perceived by stakeholders, defined through visual surveys, and modeling activities include:

- Wastewater Treatment Facilities
- Sanitary Sewer Infrastructure (centralized collection system and service lines to the centralized system)
- On-Site Sewage Facilities

- Stormwater from Urbanized Areas
- Stormwater from Rural Areas
- Illegal Dumping
- Homeless
- Pets
- Waterfowl
- Livestock and Horses
- Feral Hogs
- Roosting Grackles (or other birds)
- Wildlife (deer & small mammals)

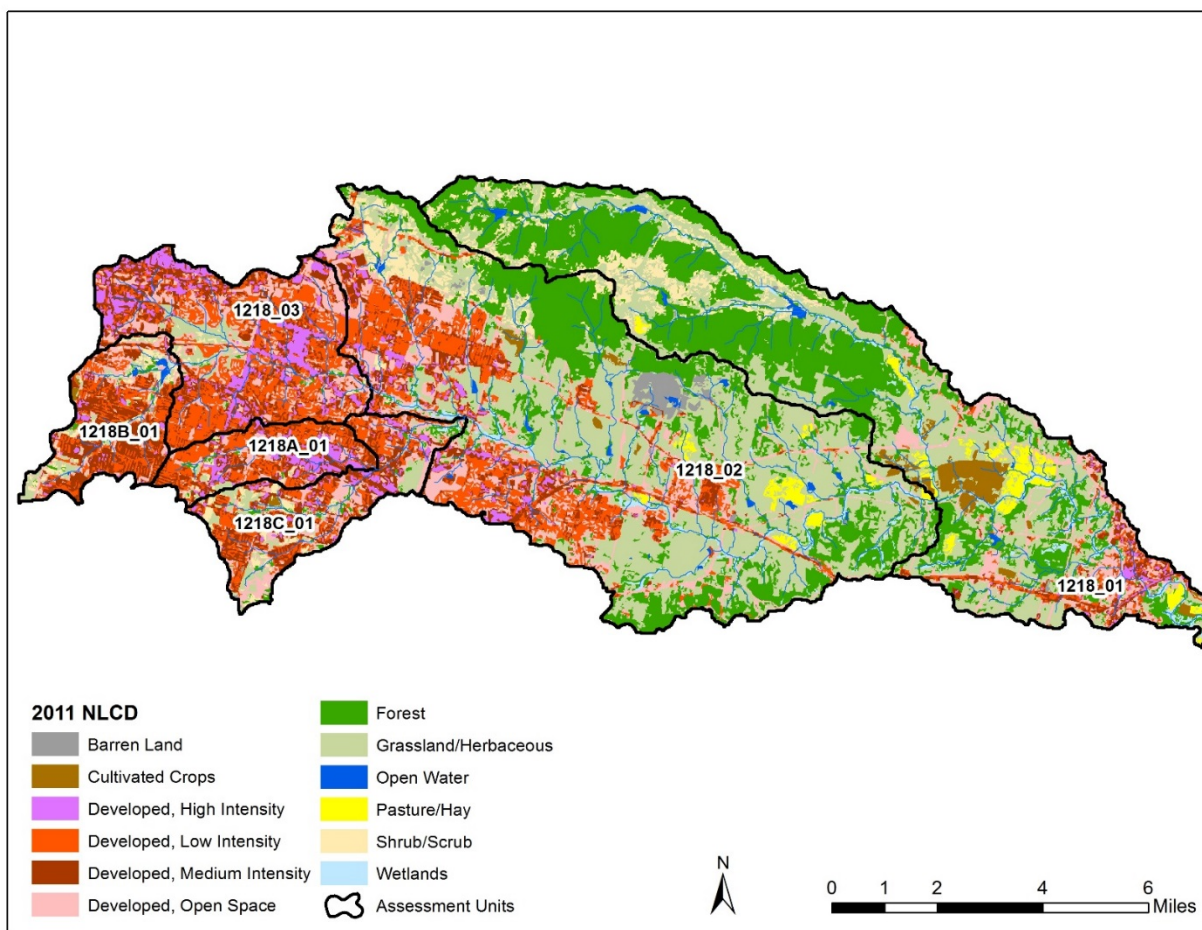


Figure 1-2 Land use/land cover for the Nolan Creek/South Nolan Creek watershed showing developed subcategories. Source: 2011 National Land Cover Database (USGS, 2014).

These sources recognize contributions from nonpoint sources associated with stormwater runoff, but also indicate issues with OSSFs and unauthorized discharges from the centralized sewer collection system as contributing factors. The use of modeling tools and monitoring has aided in

confirming a complex of rural and urban bacteria contributions within the Nolan Creek/South Nolan Creek watershed (McFarland and Adams, 2015a and 2015c).

WAP Goals and Objectives

The primary goal of the WAP is to provide management measures that when implemented will reduce instream bacteria concentrations allowing removal of impaired assessment units from the Texas 303(d) list. This goal means numerically reducing the geometric mean of *Escherichia coli* (*E. coli*) concentration based on routine monitoring data to less than 126 colonies/100 mL, the criterion for primary contact recreation within the Texas Surface Water Quality Standards. Colonies of *E. coli* may be expressed as colony forming units (cfu) or most probable number (MPN) depending on the method used for analysis. For assessment purposes in evaluating water quality within Texas, these two units (cfu and MPN) are used interchangeably.

A secondary goal of the WAP is to outline measures to reduce nutrient concentrations of nitrate and total phosphorus below screening levels of concern. Screening levels are used by the State of Texas to indicate concerns for elevated nutrient concentrations in water bodies and represent the 85th percentile of statewide data for freshwater streams (TCEQ, 2015d). For Texas, screening levels are 1.96 mg/L for nitrate and 0.69 mg/L for total phosphorus.

The management measures within this WAP highlight activities that go beyond what is already required under permit for WWTFs and within Stormwater Management Plans (SWMPs) associated with Municipal Separate Storm Sewer System (MS4) permits. Some activities outlined in SWMPs are presented to give an indication of what is already being done, but these activities are clearly differentiated from new activities proposed through the WAP. Besides complementing activities under WWTF permits and SWMPs, a third goal emphasized by stakeholders was to integrate the water quality planning effort with ongoing flood management and recreational bike and hike trail planning within the watershed, thus, coordinating these three interconnected planning efforts.

Objectives of the WAP in addressing EPA's nine elements are as follows:

- Describe management measures needed to achieve bacteria reductions,
- Estimate the technical and financial assistance needed to implement these measures,
- Describe how public understanding of planned management measures will occur through educational outreach, and
- Provide an implementation schedule for management and educational activities with interim milestones.

SECTION 2

Management Measures for Bacteria

In prioritizing a management strategy, those involved with the Nolan Creek Partnership expressed frustration that a clear dominant source is not identified. As much of the pollution appears to be from nonpoint sources, a strategy targeting multiple sources and activities will be needed. A polling of the stakeholder committee indicated that human sources should be prioritized over nonhuman sources. Of the nonhuman sources, dog waste was noted as the highest management priority. Other considerations in developing the WAP included ease of implementation, cost, potential reduction expectations, and ongoing efforts associated with SWMPs related to MS4 permits (https://www.tceq.texas.gov/permitting/stormwater/ms4/WQ_ms4_AIR.html), flood management planning efforts, and variations in recreational use along different reaches of Nolan Creek/South Nolan Creek.

Wastewater Treatment Facilities

While WWTFs are considered point source dischargers managed under permit, an overview of past issues and changes is provided as discussions by the Nolan Creek Partnership recognized WWTF discharges as a known contributing source. There are seven WWTFs that discharge within the watershed (Figure 2-1), which are managed by various entities including the City of Harker Heights, the Bell County WCIDs No. 1 and No. 3, Fort Hood, and the Brazos River Authority (BRA). An overview of status of WWTFs and issues regarding treatment, upsets, upgrades, and changes in discharges is presented below.

Issues with Inadequate Treatment

All WWTFs within the Nolan Creek/South Nolan Creek watershed currently have permits that include bacteria effluent limitations for *E. coli*. The requirement for bacteria limitations has been phased in over the past several years with permit renewals based on an amendment to the Texas Administrative Code (Title 30, Texas Administrative Code, Chapter 309.3(h), Effluent limitations on bacteria) effective November 26, 2009 (34 TexReg 8327). The limits are 399 MPN/100 mL for any single grab sample and a daily average of 126 MPN/100 mL *E. coli* for discharges to freshwater. The daily average is calculated as the geometric mean of all effluent samples collected in a calendar month (TCEQ, <https://www.tceq.texas.gov/assistance/water/wastewater/wastewater/ww-bac-t.html>).

These WWTFs monitor and report bacteria concentrations to TCEQ. Generally, bacteria concentrations in WWTF discharges have been well below the permit limitation of 126 MPN/100 mL *E. coli* for daily averages. While appropriate operation and maintenance is generally the norm, on occasion, violations have occurred. At the Nolan Creek Partnership meeting on August 17, 2017, a chart was shown of the average *E. coli* concentrations for effluent discharges from WWTFs in the watershed. A comment was made from a representative with Bell County WCID No. 1 that their WWTF (Main Plant with its discharge located just above monitoring station 18828 at 38th Street in Killeen) has experienced issues (average *E. coli* concentrations above 126 MPN/100 mL reported in January, March, and April 2017).

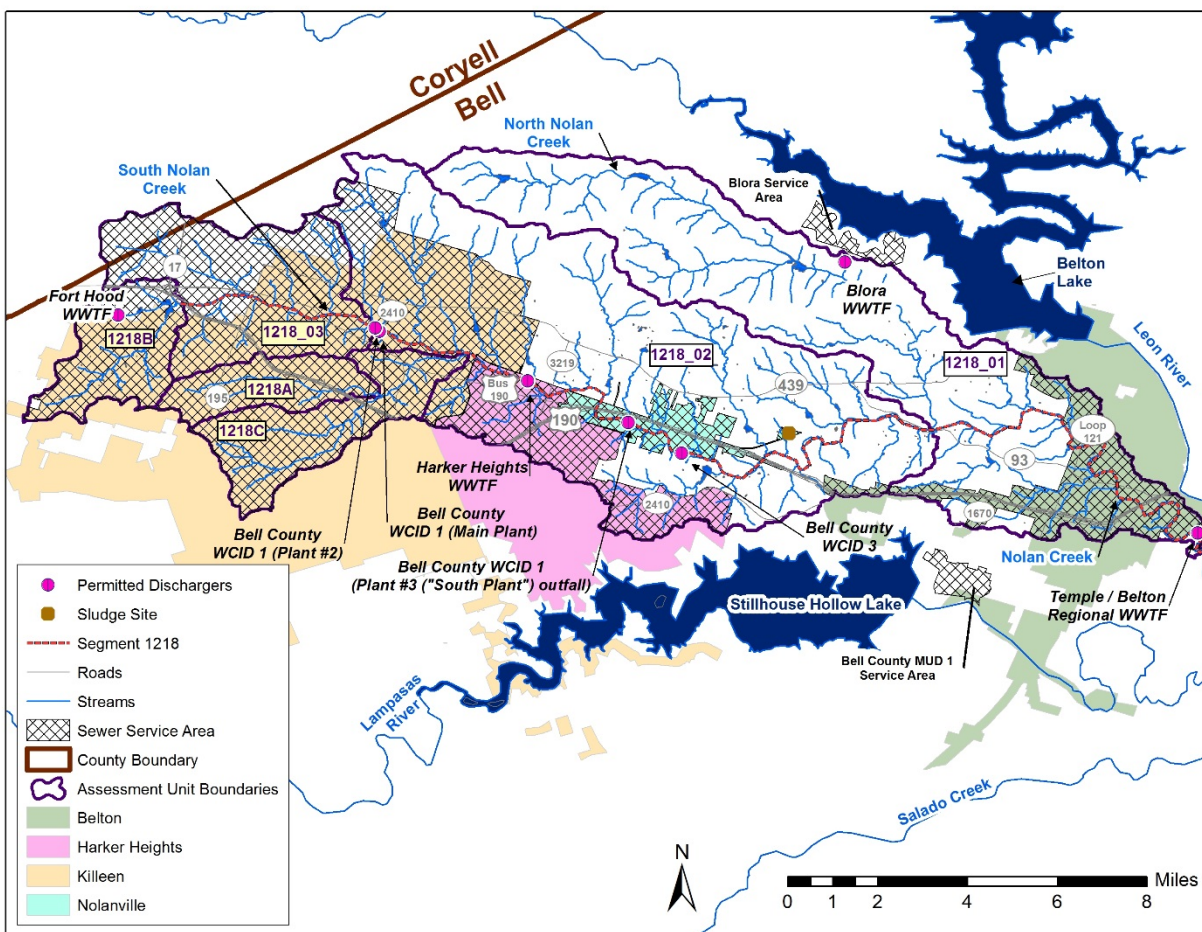


Figure 2-1 Location of WWTF discharges and service areas for wastewater collection for the Nolan Creek/South Nolan Creek watershed. Note: The service areas are based on Certificates of Convenience and Necessity (CCN) and municipal boundaries within the watershed. Some WWTFs have service areas that extend outside the watershed boundary but largely follow municipal boundaries.

Enhancements have been made at the WCID No. 1 Main Plant to address these bacteria exceedances. A new chlorine injection point has been added within the treatment plant immediately downstream from the clarifiers. Prior chlorination points were at the head of the filters and at the head of the chlorine contact basin. This new feed point gives the plant more contact time and a third disinfection point. With this new feed point for chlorine, bacteria concentrations in effluent discharged from the Bell County WCID No. 1 Main Plant WWTF should stay below permit limits.

WWTF Upsets

In 2009, a very notable breakdown at the Bell County WCID No. 1-Plant 3 occurred due to high levels of fats, oils, and grease (FOG), leading to the need for new diffusers. In response to this WWTF upset, the City of Killeen passed an ordinance that regulates FOG entering the City's sewer system. Harker Heights and Belton also address within ordinances FOG limits for wastewater entering the sewer. Additional management measures being taken to avoid future

WWTF upsets are addressed within municipal SWMPs with additional measures dealing with Sewer Line Infrastructure noted later in this document.

WWTF Upgrades

While it is recognized that the population within the watershed is growing, current WWTF capacity appears to be adequate to meet short-term needs. Most WWTFs in the watershed run well below maximum capacity under normal circumstances indicating that existing facilities are adequately equipped to handle some increases in wastewater. No significant treatment plant upgrades are planned within the Nolan/South Nolan Creek watershed within the next 10 years. The City of Killeen Comprehensive Plan indicates within Chapter 3 – Growth Management & Capacity (<http://www.killeentexas.gov/index.php?section=178>) that current contracts with WCID No. 1 for treatment of wastewater flows are adequate through at least the year 2039 before additional capacity may be needed. Other municipalities also appear to have their projected needs met.

Changes in WWTF Discharges

As of August 27, 2015, the WCID No. 1-Plant 3 (also known as the South Plant) had a permit amendment approved for a second outfall (002) to Trimmier Creek, which flows into Stillhouse Hollow Lake (Segment 1216), so a portion of the discharge from this plant will be redirected to another watershed. The WCID No. 1-Plant 3 facility is physically located south of the watershed on 8290 Chaparral Road in Killeen and will continue to discharge into South Nolan Creek within the City of Nolanville as Outfall 001. The combined flow from Outfall 001 and 002 shall not exceed 6.0 MGD for the WCID No. 1-Plant 3, with annual average flow through Outfall 2 to Trimmier Creek not exceeding 1.8 million gallons per day (MGD) from May to October and 2.2 MGD from November to April. As of August 2017, WCID No. 1-Plant 3 had not discharged any effluent to Trimmier Creek as process improvements are being completed to meet discharge limits for Trimmier Creek.

WAP Management Measures:

- Track reported bacteria concentrations associated with WWTF discharges and compare with instream water quality. Reporting responsibility is related to each WWTF via its permit. Tracking responsibilities will fall under duties associated with the Watershed Coordinator, recommended for coordinating all WAP activities, as noted later in this document.

Sewer Line Infrastructure

The sanitary sewer collection system is complex in that it provides the conduit via which raw sewage from individual homes, apartments, and businesses reaches the WWTF, where it is then treated and discharged in a safer form to the creek. Leaks, blockages, or illicit connections can lead to raw sewage within the storm drainage causing water quality issues that can emerge during dry and/or wet weather conditions. The public infrastructure must be maintained, but also the private service lines leading to the public collection system.

Public Infrastructure

Management of the public infrastructure of the sewer line infrastructure includes items, such as maintenance of the collection system, illicit discharge and elimination programs, procedures for

dealing with discharges and spills, as well as programs to minimize sewer overflows and blockages. These items related to the public infrastructure of the sewer system are largely addressed via SWMPs associated with each community. A summary of activities related to the public infrastructure of the sewer system is presented in Appendix A. These represent on-going activities within SWMPs that the WPP will support, as appropriate, through coordinating efforts.

Private Infrastructure

While not neglected, the Nolan Creek Partnership noted that private sewer lines, particularly lateral lines in high density occupancy areas, such as manufactured home communities, mobile home parks, and apartment complexes, were not as clearly addressed within SWMPs. The maintenance of these lateral sewer lines from individual homes, apartments, and businesses to the public sewer system is the responsibility of private property owners. Businesses most often associated with FOG issues are specifically addressed under various ordinances. Some educational outreach occurs to individuals, but more is needed. High density occupancy areas in particular are more vulnerable to sewage line problems than single family dwellings due to the density of users and connections leading to the centralized collection system. Often blockage problems in lateral lines occur due to tree roots, grease, or other items inappropriately entering the sewer system. Discussions within the Nolan Creek Partnership indicated that property owners in general seem to know little about their responsibilities regarding maintenance of these lateral sewer lines. One example given, when asked, some property owners did not know if they had a clean-out for their lateral line and if so, where it was located, thus, emphasizing the need for more education on maintenance of these lateral lines.

All municipalities conduct some educational outreach to the public regarding sewage lines, but consensus was that more outreach is needed beyond what is currently being conducted regarding responsibilities of private individuals for sewer line connections and maintenance of the drainage system to the public sewer infrastructure. In dealing with private sewer lines, blockages are generally obvious, but education also needs to focus on leak detection and the need for repairs when the system appears to be functioning properly. For example, the toilet flushes but not all wastewater is reaching the centralized collection system due to leaks in the lateral lines. For high density occupancy areas that may involve renters rather than homeowners, different educational pathways may be needed. To aid in reaching private individuals on this and other topics, such as pet waste management, the Nolan Creek Partnership recommends a management measure to work with a marketing expert to evaluate how best to distribute educational messages to the public. While fliers and brochures are effective at a certain level, different communication strategies may be needed, particularly in reaching younger individuals, involving social media techniques. The overall education component of the WAP, including marketing, is addressed separately under Educational Outreach.

Beyond education, a need was identified for assistance in dealing with issues with lateral lines. As high density housing areas were identified as a focus area for maintenance of lateral lines, these were also noted to likely be located in low-income areas where financial assistance may be essential, if repair or replacement of lateral lines is required. Several high density housing areas exist near or along the drainage of Nolan Creek/South Nolan Creek and proximity to the creek makes these areas a higher priority for assistance. A voluntary inspection program run through the cities to help in identifying leakage problems would be useful as well as development of a financial assistance program to aid in the repair and/or replacement of lateral lines on private

property. This should include installation of clean-outs, if not already in existence, to simplify future maintenance or repair issues. Repair costs can vary but generally range from \$100 to \$3,000, if replacement of lateral lines is needed.

WAP Management Measures:

- Educate private property owners on responsibilities regarding lateral lines.
- Educate owners and renters on how to maintain clear lateral lines.
- Educate owners and renters on how to identify leakage or blockage problems with lateral lines for wastewater located on private property and what to do when problems occur.
- Work with municipalities to develop and implement a voluntary inspection program of lateral lines on private property focusing on high density housing/population areas near the creek.
- Develop a financial assistance program for maintenance, repairs and/or replacement of lateral lines.

On-Site Sewage Facilities

Repairs or replacement of improperly functioning OSSFs and education of homeowners on how to properly maintain OSSFs were identified as high priority management measures by the Nolan Creek Partnership. While the overall potential contribution of bacteria from OSSFs was considered relatively small within the watershed, OSSFs were considered a high priority, as failures can lead to a direct source of human waste within the stream system. The risk associated with improperly functioning OSSFs, depends on the type of failure and proximity to the creek. An example of a “hard” failure or higher risk situation is when a main component of an aerobic system breaks and untreated effluent is discharged directly through its sprinkler system, which may lead to runoff into the creek. A “soft” failure would be when the pump does not work on an aerobic system. The risk associated with “soft” failures is much lower as the effluent is contained, at least temporarily, within the soil. Priority areas should focus on OSSFs closest to the stream as proximity to the creek greatly influences the potential bacteria contributions from OSSF failures.

The Bell County Public Health District, Environmental Health Division handles inspections and complaints on OSSFs throughout the watershed (http://www.bellcountyhealth.org/environmental_health_and_food_protection/introduction_on_on-site_sewage_facilities/index.php). Bell County Health noted that most OSSFs are in compliance and indicated of the 5,000 known aerobic systems in Bell County, there is a 97 to 98 percent compliance rate based on maintenance contract reports. Overall, 10 to 12 percent of OSSFs are often noted as not functioning properly when considering older anaerobic systems, but this number can vary greatly depending on the age of the system, soils, and past maintenance.

Identifying Location of OSSFs

While no map exists identifying all OSSFs in the county, Bell County Health Department (BCHD) officials are very knowledgeable of the location, general age, and type of OSSFs prominent in various locations throughout the watershed. Subdivisions with the most issues are generally older systems placed in relatively high density locations, such as many mobile home parks.

Specific mapping of OSSFs in rural areas was considered a low priority in that subdivisions in rural area with OSSFs are considered known. Use of 911 numbering and census data have also been used to highlight residences in rural areas outside municipal collection systems. Use of 2010 Census data indicated high densities of OSSFs in the area north of Nolanville. Moderate OSSF densities were indicated in the upper portion of the Little Nolan Creek watershed within Killeen, the area between Nolanville and Harker Heights, and an area northwest of Belton within the North Nolan Creek watershed (McFarland and Adams, 2015c).

A moderate priority was identification of OSSFs within annexed areas of municipalities, so removal can be addressed. The City of Killeen has taken steps to map and identify OSSFs within its municipal boundaries. As part of its SWMP, the City of Harker Heights is developing an inventory of OSSFs and categorizing them as currently in use or historic when tied into the centralized sewer system. The Fort Hood SWMP also includes development of an inventory of all OSSFs. Other municipalities based on annexation maps and the extension of city services have information on the general location of OSSFs, but not detailed maps. One method suggested for tracking annexed houses still on OSSFs, should detailed information be desired, is querying billing databases to determine who is paying for sewer, assuming this is charged separately from other city services. As these maps are developed, they should be shared with the Watershed Coordinator and other pertinent entities in the watershed, such as BCHD.

As cities continue to grow, city officials are aware that the city will be annexing subdivisions on OSSFs and will need to bring these houses onto the centralized wastewater system. Almost all rural subdivisions on OSSFs within the watershed are part of the extra territorial jurisdiction (ETJ) of a municipality, and, thus, likely to be annexed.

For new subdivisions in rural areas, developers should be encouraged to install smaller centralized OSSFs, such as package wastewater treatment plants, rather than individual OSSFs. Smaller centralized OSSFs provide a simple treatment system that is generally considered more environmentally friendly.

WAP Management Measures:

- Work with municipalities and Bell County Health to locate OSSFs, particularly those close to the creek.
- Work with municipalities to develop and maintain an inventory of OSSFs still in use and those that have been connected to the centralized wastewater collection system within municipal boundaries and share OSSF maps/databases with watershed coordinator and other entities in the watershed.
- Work with Bell County to provide a mechanism to encourage installation of smaller centralized OSSFs in new subdivisions rather than installing individual OSSFs with each house.

Removal of Annexed OSSFs within Municipal Boundaries

For municipalities, a priority is removing OSSFs within their boundaries and connecting these systems to the centralized sewer system. Generally, as long as an OSSF is functioning properly on annexed property, the land owner is not required to connect to the centralized sewer system. Once an OSSF fails, the land owner is then obligated to connect, assuming centralized sewer service has been extended to the annexed area. Ideally, OSSFs on annexed properties would be

connected to centralized sewer system prior to failure, but the cost of OSSF removal and connection to the centralized sewer system is not insignificant, and financial incentives may be needed to assist some land owners.

- Connecting to city sewer lines – cost depends on circumstances, such as distance, slope, and soil type (cost estimate \$2,500 per connection but could run much less or thousands more depending on location).
- In some locations, it may not be practical to connect to the centralized sewer system for example if centralized sewer lines have not yet been run into an annexed area with OSSFs or the location makes it prohibitive for some other reason. Municipalities are recommended to adopt options for when such circumstances occur. In these rare circumstances, replacement or repair of failing OSSFs may need to be considered. The burden of the cost would be the responsibility of the private property owner.
 - OSSF Replacement (cost estimate \$5,000 to \$10,000 each)
 - OSSF Repair (cost estimate \$1,000 to \$5,000 each depending on type of repair needed)
- Decommissioning of OSSFs no longer in use (cost about \$2,000 each).

Within the Nolan Creek/South Nolan Creek watershed, some assistance programs already exist. The most prominent is the Septic Tank Elimination Program (STEP) implemented by the City of Killeen. Phase 10 of STEP was approved in July 2017 by the Killeen City Council focusing on homes in the Tucker Subdivision at 6000 S. Clear Creek Road within the Little Nolan Creek subwatershed. The City of Belton has a “Home Grant” program to aid qualified, low income families with building new or bringing an existing property up-to-code. This “Home Grant” can be used to assist homes on OSSFs in connecting to the city sewer. Other assistance options for aiding private property owners with removal of OSSFs and connecting to centralized wastewater systems are needed and some potential funding sources are outlined in the section on Financial and Technical Assistance Needs. The Watershed Coordinator in conjunction with municipalities should work to identify further funding sources for OSSF removal.

WAP Management Measures:

- Work with municipalities and BCHD to target removal of OSSFs, particularly those close to the creek.
- Have the Watershed Coordinator work with municipalities in identifying and providing financial assistance for connection of households to the centralized sewer system and removal of decommissioned OSSFs.

Assistance with Maintenance and Repairs of OSSFs

Within municipalities, the goal is to remove OSSFs and connect to a centralized wastewater collection system. Within rural areas, proper maintenance of OSSFs is the goal, which includes knowing when problems exist and making repairs or replacing a failing OSSF system. Inspections are conducted when new systems are first installed, and for newer aerobic systems, a maintenance contract is required to inspect the system once every four months. Inspection results for aerobic OSSFs are submitted to the BCHD. For anaerobic systems, inspections are not required but recommended every three to five years. With changes in homeownership, real estate inspections may be requested of BCHD for which BCHD will check records for anaerobic systems to note if inspection reports have been submitted and any issues reported.

The BCHD will make physical inspections in response to compliance complaints. Otherwise, BCHD is reliant on accepting inspection reports from licensed maintenance and inspection companies. Failure to report inspections for aerobic systems or failure to address inspection compliance issue can lead to a letter from BCHD. When a letter is sent, the homeowner is generally given 30 days to fix issues and come into compliance. If issues with an OSSF (aerobic or anaerobic) are not addressed within the prescribed timeframe, then a court case is generally filed. The court then may fine the homeowner (generally only about \$200), and the court may order repairs. The BCHD noted that even working through the courts, this does not necessarily mean the problem gets fixed as the timeline for dealing with the OSSF compliance issue is generally reset by the court. The BCHD tries to work with property owners, but it can be difficult to obtain consistent compliance when potential fines are relatively low and repairs may cost thousands of dollars. Within municipalities, BCHD does work with city governments as leverage in dealing with compliance issues. In part the issue with dealing with failing OSSFs is financial, as often failing systems are older systems in rural subdivisions representing economically disadvantaged individuals.

Costs –

- OSSF Replacement (cost estimate \$5,000 to \$10,000 each)
- OSSF Repair (cost estimate \$1,000 to \$5,000 each depending on type of repair needed)

Other issues, besides inspections and compliance, discussed with regard to rural OSSFs included minimum lot size for OSSFs (half an acre set by the State of Texas). A half-acre was considered too small a plot of land for an OSSF by stakeholders involved with the Nolan Creek WPP, because if the homeowner also wants things, such as an outdoor kitchen, patio area, play area and/or pool, the sprinkler spray pattern for an aerobic system likely will overlap these other items. As mentioned under locations of OSSFs, there is a desire to have new developments install smaller, centralized sewer systems as more environmentally friendly than individual OSSFs, but financial or other incentives are likely needed, as installing individual OSSFs is still a cheaper option for developers in most areas.

WAP Management Measures:

- Make recommendations to the State of Texas via TCEQ to increase the inspection requirements for OSSFs and the companies licensed to inspect OSSFs. Goal to increase inspections, but also increase the leverage of county health departments in dealing with compliance issues.
- Make recommendations to the State of Texas via TCEQ to increase the minimum lot size required from half an acre to at least one acre for individual OSSFs.
- Through the county and the State of Texas, promote installation of smaller, centralized OSSFs in new rural subdivisions rather than individual OSSFs.
- Develop and provide financial assistance program for those with OSSF compliance issues to aid in repairing or replacing failing systems, prioritizing those nearest the creek.

Education on OSSF Maintenance

Education on the maintenance, detection of issues, and repairs of OSSFs was noted as a need throughout the watershed. Focus areas for education would be those OSSFs closest to the creek. New homeowners and renters were also considered focus groups for OSSF education as individuals who may have limited experience with OSSFs. Educational efforts should also target

realtors and landlords, who are likely to interact with new homeowners and renters. Education for installers and maintenance providers was also recommended by the Nolan Creek Partnership. Training workshops on OSSFs as presented through Texas A&M AgriLife Extension Service are further discussed in Section 3, Educational Outreach.

WAP Management Measures:

- Sponsor OSSF workshops/trainings for homeowners.
- Sponsor OSSF workshops/trainings for installers and maintenance providers.

Public Involvement in Good Housekeeping Efforts

Homeless

The homeless population within the watershed, while recognized, was not considered a significant contributing source of bacteria until fairly recently. An increase in the number of homeless camps along Nolan Creek and an increase in the number of individuals within each camp has been observed as well as a large increase in human defecation within public rights of ways (streets, alleys, and sidewalks). While at this time, the Nolan Creek Partnership does not have specific management measures defined to deal with the bacteria contributions from the homeless, a management measure will include working with municipalities, particularly the City of Killeen, as well as organizations that deal with the homeless or low income individuals and families to help define how best to address this source.

WAP Management Measures:

- Work with municipalities and other organizations in defining management measures that address the bacteria contributions homeless population within the watershed.

Pet Waste

Getting people to pick up dog waste seems to be a problem in most watersheds and Nolan Creek/South Nolan Creek is no exception. Dog waste was considered by Nolan Creek Partnership as the highest priority of non-human bacteria sources for management measures. Modeling results supported this in indicating pet waste as the largest potential source in many predominately urban subbasins (McFarland and Adams, 2015c). Over 43,000 dogs are estimated to live in the watershed with the highest densities in urban residential areas (McFarland and Adams, 2015c; assumes 0.8 dogs/household and 53,774 households in the watershed based on 2010 Census data). Ordinances are in place in all municipalities in the watershed to deal with dog waste. Enforcement through inspections of businesses, such as kennels and veterinary clinics, occurs, but enforcing these ordinances with the general public is more problematic. Most municipalities provide educational pamphlets, brochures, and even some signage to aid in educating the public regarding dog waste, but more and likely a different approach to education on pet waste is needed. Even in dog parks, such as Mickey's Dog Park in Killeen, where waste stations and bags are provided and signage clearly indicates the requirement to pick up dog waste, city employees often are left picking up large amounts of dog waste because people are not utilizing these resources.

To address pet waste as a bacteria source, an education campaign that builds upon what is currently being done is recommended focusing on the importance of picking up pet waste. Critical areas would include parks, particularly dog parks, and other green spaces, such as hiking

trails, where people are likely to recreate with their dogs. Booker Green Space at the end of Ann Boulevard in Harker Heights is an example of a public green space very near the creek. Dog parks near but not directly in the watershed should also be targeted, as practices learned in dog parks hopefully would carry over when people recreate with their dogs within the watershed. For example, the dog park in Harker Heights (Purser Family Park) is outside of the watershed, but if people are using it, they are also likely to live or recreate with their dogs in parks within the Nolan Creek watershed. For homeowners, the critical area was considered those nearest the creek as close proximity is more likely to lead to pet waste in the creek if not picked up and properly disposed. Ways to target educational efforts to homeowners with backyards that abut Nolan Creek/South Nolan Creek should be considered in the educational outreach component. As with education on residential sewer lines, tapping into marketing expertise is recommended to aid in targeting the pet waste control message. Creative pet waste campaigns may be needed to get more people engaged in picking up dog waste. Examples are provided on the following website outlining some of the more bizarre campaigns pushing people to pick up dog waste (<https://www.petpooskiddoo.com/blog/10-bizarre-campaigns-pushing-people-to-pick-up-dog-poop/>).

Along with this pet waste education campaign, the installation and maintenance of more pet waste stations in parks and along hike and bike trails where people are likely to walk dogs should be evaluated and considered by municipalities.

Cost – about \$650/station with maintenance about \$300/yr

WAP Management Measures:

- Support and expand on public outreach and educational programs by municipalities encouraging proper disposal of pet waste.
- For the entire watershed area, develop a pet waste pick-up campaign.
- Support use and provide additional pet waste stations in public areas within the watershed.

Illegal Dumping

Illegal dumping often has been observed in the watershed adjacent to bridges, and this trash, particularly if it involves animal carcasses, can be a direct source of bacteria to the creek when a decaying carcass washes into or is dumped into the creek. Certain parts of Nolan Creek are “dumping areas” while others, such as Levi Crossing, are known to accumulate trash after storm events as trash washes downstream. Currently, illegal dumping is largely dealt with on a complaint basis or when observed by municipal or county employees. Most SWMPs include educational brochures as an effort to reduce illegal dumping.

The WAP supports ongoing efforts associated with SWMPs and will look for opportunities to expand upon these educational efforts. The TCEQ is working to implement a “Don’t Mess with Texas Water” program working with Texas Department of Transportation (TxDOT) and participating communities to place signs on major highway water crossing notifying drivers of a toll-free number to call to report illegal dumping (<https://www.tceq.texas.gov/p2/dont-mess-with-texas-water-a-way-to-report-illegal-dumping#get-involved>). The Nolan Creek Partnership would be interested in participating in this signage program.

Trash and Hazardous Waste Management

Creek cleanups and household hazardous waste (HHW) programs are two approaches already being used to reduce illegal dumping in the watershed. Creek cleanups are supported within several SWMPs and include activities, such as the annual clean up Lowes Boulevard Creek, a tributary to Little Nolan Creek, sponsored by Keep Killeen Beautiful in association with the Keep Texas Waterways Clean program. The Keep Texas Waterways Clean program provides support and supplies for waterway cleanups across Texas and is open to all affiliate and non-affiliate communities located within 30 miles of an H-E-B or Central Market store location (<https://www.ktb.org/keep-texas-waterways-clean>). Fort Hood hosts a post-wide cleanup program typically twice per year that includes some of the stormwater conveyances. The City of Nolanville within its SWMP includes development of an Adopt-A-Stream program in partnership with the Killeen Independent School District (target date 2020), which would include a creek clean up to help familiarize and educate students on the importance of creeks and keeping them clean. The Nolan Creek/South Nolan Creek WAP will support creek cleanup efforts and plans to promote at least one additional creek cleanup a year in the watershed as a way to connect people to the creek and educate them on trash management. Estimated costs for additional events is about \$2,000 per event for supplies and advertising.

Household hazardous waste programs are estimated to cost about \$12,500 per event, so they can be fairly expensive to conduct and, thus, individual HHW events are often supported by several entities. Within the watershed, the Central Texas Council of Governments through its Solid Waste Advisory Committee (SWAC) coordinates about three household hazardous waste events in communities near and in the Nolan Creek watershed per year (<https://ctcog.org/regional-planning/resource-conservation/>). These events are open to all residents of Bell, Coryell, Hamilton, Lampasas, Milam, Mills, and San Saba counties. Bell County also partners in sponsoring HHW events and annually sponsors a collection of waste tires event. Fort Hood Department of Public Work, Environmental Division, operates a HHW turn-in and reissue facility open daily during normal business hours, which accepts typical household products (e.g., cleaning products, paint, oils, or greases) that can be reused by others. The City of Belton includes within its monthly rate for residential garbage a fee to handle HHW with home pickup (http://www.belontexas.gov/departments/public_works/solid_waste_services.php). Another option for disposal of HHW is the Williamson County Recycle Center (WCRC). The WCRC is a commercial HHW facility located at 495 County Road 156, Georgetown that accepts HHW from residents in Bell, Travis, Burnet, Milam, and Williamson counties on a fee basis (<http://www.mytexashhw.com/accepted-chemicals/>). With all these options for HHW disposal, the Nolan Creek Partnership plans to promote education of these options for HHW disposal and HHW events sponsored by other entities through newsletters, website, and other outreach avenues.

Dead Animal Disposal

Education on proper disposal of dead animals (includes wildlife, pets, and livestock) is also needed beyond what is currently being conducted. Disposal of dead animals within riparian corridors, often at bridge crossings, leads to bacteria in the stream as carcasses decay. The number of dead animal being disposed of in the creek is unknown and difficult to quantify but undesirable even if limited. People need to be aware of the impacts of improper dead animal disposal and how to properly dispose of dead animals. Per ordinance, municipalities within the watershed do not allow disposal of dead animals with garbage collection, but disposal via burial

on private lands is allowed. For pets, veterinary clinics for a fee can aid with arrangements for dead animals, which can include cremation and/or burial. For dead animals noticed in the creek or on city streets within municipalities, cities may be contacted, but if on private property, the property owner is responsible for disposal either directly or through a commercial venue. For dead animals on county roads, the Bell County Engineer's Office may be called (254) 933-5275 for carcass removal (http://www.bellcountytexas.com/departments/engineer_2/fqa.php). The TCEQ has Special Waste Disposal Information, which includes guidelines for dead animals https://www.tceq.texas.gov/permitting/waste_permits/msw_permits/msw_specialwaste.html. As part of the education component of the WPP, the Watershed Coordinator will include information on proper disposal of animals within newsletters, website, and other outreach venues.

WAP Management Measures:

- Implement signage at major highway crossing on how to report illegal dumping.
- Support and aid creek cleanup events planned by other entities and sponsor at least one separate creek cleanup event per year.
- Promote available options for HHW disposal and planned HHW events through newsletters, website, and other outreach venues.
- Use HHW and creek cleanup events as an opportunity for educational outreach to reduce illegal dumping.
- Promote educational information on proper trash and dead animal disposal through newsletters, website, and other outreach venues.

Urban Stormwater Management

Within urbanized areas, SWMPs are required to address management practices associated with maintenance of the storm drainage system. As mentioned previously, all SWMPs include IDDE programs, but they also focus on dealing with pollution prevention and good housekeeping for municipal operations, construction site stormwater runoff control, post-construction stormwater management in new development and redevelopment areas, and for larger MS4 areas (populations 100,000 or greater) industrial stormwater sources. The WAP for the Nolan Creek/South Nolan Creek supports these SWMPs. While not a comprehensive listing, within Appendix B are listed some of the activities related to municipal operations, construction, post-construction, and industrial sources within SWMPs of entities within the watershed.

Increasing Infiltration and Reducing Runoff

With regard to post-construction measures as related to increasing infiltration, the Nolan Creek Partnership considered this an area where activities beyond those in current SWMPs should be considered. A larger promotion of low impact development (LID) practices was seen as useful including demonstration projects to promote implementation and more extensive education on the benefits of LID practices.

The purpose of LID is to reduce runoff by increasing infiltration into the ground or redirecting runoff to storage for reuse at a later time. While LID may have greater upfront costs than conventional development practices, one of its promoted benefits is a reduction in infrastructure upkeep costs. Implementation of LID can create a more permanent solution for nonpoint source water quality problems, if enough is installed correctly. Practices associated with LID include:

- Rainwater harvesting, which reduces runoff by capturing it for household or commercial use at a later point in time.
- Bio-retention, which is probably the most common LID practice, where stormwater is retained within a treatment area, such as a grass buffer strip or ponding area. Bio-retention does not prevent all runoff, but slows it down allowing more infiltration and filtering of pollutants as some pollutants, such as sediment, may settle out as runoff slows. Rain-gardens are considered a type of bio-retention with vegetation making use of the stormwater retained.
- Bioswales are stormwater conveyance systems filled with vegetation and a porous base allowing drainage. Bioswales are designed to slow runoff allowing more infiltration of the first flush of storm events and the filtering of larger events. Bioswales are often promoted as an alternative to concrete stormwater drainage systems.

Municipalities with the watershed are supportive of LID, but upfront costs are noted as a hindrance in getting developers and other to implement LID practices. The Nolan Creek Partnership supports LID and will look for ways to promote its adoption. Education on LID involving professionals, city staff, developers, business owners, and homeowners would be useful and should be promoted. Demonstration sites of LID practices would aid in promoting them as effective stormwater management measures, and the City of Nolanville is interested in implementing bioswales and is actively pursuing funding for their implementation, which the WPP supports. More details regarding specific locations for these bioswales within Nolanville and how they would be used for demonstration and monitored for effectiveness is outlined in Appendix C.

Another activity defined by the Nolan Creek Partnership involves the promotion of Residential Cluster Development (also known as open space development) in new subdivisions by grouping residential properties on smaller lots and using the “extra land” as open space to reduce overall impervious area and increase greenspace (i.e., reduce runoff and increase infiltration) is also recommended. Similar to LID, this can be very effective practice in decreasing potential nonpoint source pollution, but may encounter resistance from developers as many people who move out into the countryside desire larger lots sizes rather than smaller.

WAP Management Measures:

- Support practices outlined SWMPs, particularly those associated with post-construction stormwater management in new development and redevelopment areas that increase infiltration and reduce runoff, through coordinated educational efforts.
- Specifically promote LID practices through educational workshops.
- Support funding efforts for the implementation and demonstration of LID practices by municipalities and other entities (e.g., Nolanville’s implementation of bioswales).
- Promote Residential Cluster Development for new developments.

Practices that protect green spaces also provide ways to slow down runoff, thus, increasing infiltration and filtering pollutants before runoff water reaches the stream. The desire to preserve and connect green spaces throughout the watershed has been noted by stakeholders and is part of a long-term vision to connect hike and bike trails from Killeen to Belton largely following the riparian corridor of Nolan Creek/South Nolan Creek. Practices to increase infiltration tie into practices also being considered as part of flood management planning, such as detention ponds,

bio-retention ponds, and bioswales. More specifics regarding recreational use and flood management are addressed in a separate section of this report.

Rural Stormwater Management

Livestock Waste

In evaluating potential bacteria sources, livestock were identified as the largest potential source in subbasins that were predominately rural (McFarland and Adams, 2015c). Beef cattle are the primary livestock in the watershed, but sheep and goats are also prominent. While primarily a rural issue, there is also a need to target livestock owners within municipal boundaries. Livestock are excluded by city ordinances from within municipal boundaries, but annexed areas exist where livestock are present, as agricultural use of these lands has continued post-annexation. There are no Concentrated Animal Feeding Operations (CAFOs) in the watershed, but some relatively small land holdings have been noted that may have fairly high densities of livestock requiring a focus on manure management. Another focus area is land holdings with livestock near the creek, as close proximity is more likely to lead to livestock waste in the creek either through runoff or direct deposition. Education is needed to create awareness and aid with planning and implementation of livestock management practices that move or minimize the time livestock spend in or near the creek to reduce the amount of livestock waste entering the creek.

Besides educational outreach, the Nolan Creek Partnership plans to promote development of water quality management plans (WQMPs) for agricultural or silvicultural lands through the Texas State Soil and Water Conservation Board (TSSWCB), which are approved through the Central Texas Soil and Water Conservation District (SWCD) (<https://www.tsswcb.texas.gov/programs/water-quality-management-plan>). As each operation is different, each WQMP provides a site-specific plan. The plan includes appropriate items, such as land treatment practices, production practices, grazing management measures, and technologies, needed for preventing or abating pollution to aid in meeting water quality standards. Having a WQMP also allows ranchers or farmers to leverage some financial assistance programs at the state and federal levels.

The Natural Resource Conservation Service (NRCS) also provides conservation planning as technical assistance to private landowners and others as a voluntary program (<https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/cp/>).

Landowner assistance for forest and riparian management can also be obtained from the Texas Forest Service (TFS) with planning efforts encompassing water resources as well as vegetation management (<https://tfsweb.tamu.edu/LandownerAssistance/>).

While the cost of planning through TSSWCB, NRCS, and TFS is generally free, the implementation of these plans can be expensive. For limiting bacteria, the most effective management measures target direct deposition and limiting the time livestock spend in or near the creek. This may require alternative water sources, rotational grazing options, and/or fencing. Effectiveness then depends on the willingness of livestock owners to put in the additional effort needed to implement these plans. While the technical assistance in developing a plan is generally free, implementation of practices outlined in a WQMP or conservation plan is roughly estimated at \$15,000 per plan.

WAP Management Measures:

- Educate livestock owners on good management practices for maintaining healthy streams via workshops and distribution of educational resources.
- Develop awareness of the planning process for WQMPs, conservation plans, and other planning options.
- Promote development and implementation of WQMPs, conservation plans, or other conservation plans by livestock owners in the watershed.

Horse/Stable Waste

While horses are often categorized as livestock, they are more often considered pets and, thus, presented as a separate category in the WAP. Waste management efforts, while similar to those for livestock, will need to target a different audience in dealing with horses. Horses are likely on smaller acreages than grazing beef cattle, and stables/boarding facilities should be targeted as well as individual horse owners. The same planning processes available to livestock owners are available to horse owners through WQMPs and conservation plans. Manure, even if on a smaller scale, should be managed including stockpiled manure from stalls or other areas, particularly if it is then land applied as organic fertilizer.

WAP Management Measures:

- Educate horse owners on good management practices for maintaining healthy streams via workshops and distribution of educational resources.
- Develop awareness of the planning process for WQMPs, conservation plans, and other planning options.
- Promote development and implementation of WQMPs, conservation plans, or other conservation plans by horse owners in the watershed.

Feral Hogs

While characterizing sources within the watershed, feral hogs were considered a relatively small issue with most activity noted along North Nolan Creek in wooded areas outside the targeted assessment areas. More recently extensive hog activity has been noted within the urban areas along the creek within Harker Heights. Because hogs are transitory but very prolific, the need for hog management is considered a low to moderate priority that could shift as the hog population fluctuates.

Hog reduction efforts are mainly done through shooting and trapping by private land owners. Texas Wildlife Services (<https://agrilife.org/txwildlifeservices/>), which is a division of Texas A&M AgriLife Extension, provides technical assistance in feral hog control. Hogs for a Cause (<http://www.hogsforacause.org/>) in Belton (contact: Dave Haehn) is a nonprofit feral hog capture organization that provides the meat to struggling families. While a nonprofit, Hogs for a Cause charges about \$10 a head largely to recoup their costs. These hogs must be caught live for meat processing as they fall under United States Department of Agriculture (USDA) meat inspection guidelines. The Hogs for a Cause organization currently has a processor willing to work with them to process trapped hogs, and they are looking to build their own processing plant dedicated to this endeavor. For individuals wanting to trap hogs themselves, traps can cost about \$500 and upwards.

WAP Management Measures:

- Educate landowners on management measures to aid in hog reduction.
- Promote management options, such as Hogs for a Cause, to help with trapping.

If feral hogs become a larger problem, the Nolan Creek Partnership, on review of the WAP, may consider coordinating trapping and hunting with Texas Wildlife Services and/or hiring a county trapper. Other watersheds have considered supporting a bounty program for feral hogs, but only in areas where feral hog populations are considered a large portion of the bacteria source problem.

Other Sources

Roosting Birds

High densities of roosting birds have been noted as a problem in the watershed mainly at two locations, on the power lines near the Home Depot in Killeen and in the H-E-B parking lot along Trimmer Road in Killeen. Both of these locations are near or along Little Nolan Creek. While roosting birds can be a public nuisance, the property owner where the birds roost is responsible for control measures, if implemented.

Control methods for roosting birds, such as grackles, involve various frighten tactics to discourage roosting or the removal of roosting habitat. Grackles, starlings, and blackbirds that are causing damage or creating a nuisance are not protected by state or federal law (Texas A&M AgriLife Extension – http://counties.agrilife.org/ector/files/2011/07/11921_18.pdf), and Texas Wildlife Service can aid with developing a plan to deal with roosting birds. The cost can vary depending on tactics implemented and the frequency of implementation. The effectiveness of frighten tactics can be limited as they must be repeated and often varied as birds may become accustomed to any one frighten method. There also is the likelihood that these birds may just move to another nearby location, thus, moving the problem to another area rather than truly solving it.

WAP Management Measures:

- Make landowners aware of assistance available from Texas Wildlife Services on methods for decreasing attractiveness of areas to roosting.
- If a discouragement or frighten plan is developed, assist with education of the public regarding proposed tactics.

Wildlife (including waterfowl)

Deer and small wildlife mammals, such as skunks, opossums, and raccoons, are considered minor contributors to the bacteria issue in the watershed. Deer, as larger mammals, are primarily found in the more rural portions of the watershed, although riparian corridors can act as passage ways for deer into more urbanized areas. High densities of deer are also not considered a problem in this watershed based on stakeholder feedback. In dealing with smaller mammals that may congregate, particularly in municipalities if a food source is made available, when queried, this has not been considered a major problem by stakeholders. Waterfowl, particularly in the park areas along the Nolan Creek near Belton, have been noted. Signage “Do Not Feed Waterfowl” would be useful in known feeding areas. While watersheds with high densities of

waterfowl have considered removal management measures, at this time preventive measures are considered most appropriate in the Nolan Creek/South Nolan Creek watershed.

Preventative measures include educational outreach to the public on the issues associated with feeding small mammals and waterfowl. Public awareness and educational campaign on why feeding ducks and other wildlife can contribute to higher bacteria concentrations within the creek should aid in reducing and keeping waterfowl and wildlife populations at reasonable levels. Assistance is available from Texas Parks and Wildlife Department (TPWD) for outreach activities and in developing removal plans, should they become necessary.

Other preventative measures focus on landowner planning assistance programs. Similar to planning efforts for livestock, WQMPs, conservation plans, and assistance from the Texas Forest Service is available to deal with wildlife management, water resources, and vegetation management. The Texas Parks and Wildlife Department also offers a number of services and permits to aid with land management related to wildlife (<https://tpwd.texas.gov/huntwild/apps/>).

WAP Management Measures:

- Provide educational programs to the public to discourage feeding of waterfowl and small mammals.
- Add signage “Do Not Feed Waterfowl” in known feeding locations.
- Monitor population densities to assess if further management is needed.
- If population densities are considered large enough to warrant control, consult with TPWD on options for control.
- If deemed necessary, implement population control measures.
- Promote landowner use of conservation planning for wildlife through TSSWCB, NRCS, TFS, and TPWD.

Recreational Use and Flood Management

As part of the WAP, there is an overall desire by the Nolan Creek Partnership to merge the water quality planning process with initiatives focused on recreational use, including hike and bike trails, and flood management.

Recreational Use

As the bacteria impairment is closely associated with recreational use, how the creek is used is important to its management. Recreational use of South Nolan/Nolan Creek varies from its headwaters northwest of Killeen to its confluence with the Leon River southeast of Belton. Low flows generally limit recreational use of the creek within Killeen and Harker Heights to noncontact activities, such walking or biking along trails near the creek. As flows increase, secondary contact recreation activities increase, such as fishing and wading by adults, which has been observed below US 190 in Nolanville. More downstream during periods with adequate baseflow, kayaking and canoeing occur, particularly within the City of Belton from Martin Luther King Jr Avenue to Confederate Park. For longer kayaking trips, the crossing South Nolan Creek with Farm-to-Market 93 or Backstrom Crossing are noted as potential input points. While discouraged, primary contact recreation activities do occur in Belton parks. This includes swimming and wading by children.

The City of Belton encourages kayaking and safe usage of Nolan Creek from within its parks. An important issue that the City of Belton has emphasized is the need for more education of the public on safe usage of the creek. This would include not only education due to elevated bacteria concentrations but also increasing water levels that occur with storm events. Flooding or even smaller increases in water levels that can create dangerous stream conditions making direct use of the creek unsafe. Within the watershed, there currently is some signage encouraging secondary recreation is displayed within Belton City Parks along the creek. The Nolan Creek Partnership will promote via additional signage and on its website and other venues information regarding water quality and water levels of Nolan Creek and safe usage of the creek.

As part of the recreational use of Nolan Creek/South Nolan Creek several hike and bike trails exist near the creek, such as the Andy K. Well Hike and Bike Trail in Killeen and the Nolan Creek Hike and Bike Trail in Belton, which connects several of the Killeen parks. Harker Heights also has a trail near the creek, and Nolanville is in the planning stages for developing a trail system. An ultimate goal expressed was for a trail system connecting municipalities throughout the watershed from Killeen to Belton much of which would be along the creek. In 2016, the Bicycle and Pedestrian Advisory Committee (BPAC) was established by the Killeen-Temple Metropolitan Planning Organization (KTMPO) Transportation Planning Policy Board with the purpose of improving bicycle and walking mobility within the Killeen-Temple Region (<https://ktmopo.org/planning/bike-and-pedestrian/#1455811352-1-90>). The BikePed App supported through KTMPO provides a map of bike and pedestrian facilities including future projects suggested by citizens (<https://ctcog.maps.arcgis.com/apps/webappviewer/index.html?id=4585c0739c5c4b25a74f38f4d8e4e941>). It is important that the Nolan Creek/South Nolan Creek WPP be coordinated with bike and pedestrian trail programs. Particularly as many of these Hike and Bike trails planned and currently in existence are near or along the creek, they provide areas for outreach to the public on water quality where signage could be established for educational purposes. Planning efforts for these trails should also consider protection of the riparian area to the creek, and may also increase the need for trash and pet waste stations as more individuals recreate near the creek. The Nolan Creek Partnership will support and promote the implementation of educational signage as well as pet waste stations along these trails.

Using the floodplain for parks and trails, takes this land out of development (Waller Creek in Austin example in progress, <https://www.wallercreek.org/>). The City of Killeen has purchased undeveloped land in the floodplain to better control management within these riparian areas. Development pressures can make the acquisition and control of riparian areas difficult as people like to build along waterways as these are often considered aesthetically pleasing locations, but other uses may be more appropriate to aid water quality improvements and flood control. The Nolan Creek Partnership will support opportunities to protect the creek through riparian buffers that could be associated with trails.

WAP Management Measures:

- Promote safe usage of Nolan Creek/South Nolan Creek through educational information provided via website and other venues.
- Coordinate WAP activities with creek recreational activities promoted by municipalities often associated with city parks as well as through planning and maintenance of bicycle and pedestrian trails.

- Support implementation of more trash and pet waste stations in areas near the creek associated with increased recreational use.
- Support implementation of educational signage within parks and along trails.
- Support development of riparian buffers as part of trail systems associated with the creek corridor.

Flood Management

The Central Texas Council of Governments (CTCOG) has received a grant through the Texas Water Development Board (TWDB) to conduct a flood protection planning study for the Nolan Creek watershed. This flood protection study started in February 2017 and should conclude in August 2019. Goals of the study include developing a hydrologic model of the watershed that will be used to identify problem areas associated with flooding and mitigation alternatives including a benefit/cost analysis. Further information regarding the Nolan Creek Flood Protection Planning Study can be found on the CTCOG website at:

<https://ctcog.org/regional-planning/nolan-creek-flood-protection-planning-study/>

The Nolan Creek Partnership understands there is a connection between flood management and water quality management and is supportive of the Nolan Creek Flood Protection Planning Study. Outcomes from this study will be used to inform efforts in implementing water quality management measures. This flood protection planning process will aid in determining the best locations for detention or bio-retention ponds for flood management, which will aid bacteria abatement through settling of stormwater runoff. Flood planning should also address concerns from stakeholders regarding increased peak flows that have led to an increase in streambank erosion and in essence, property loss. Upstream urbanization (more concrete) has been voiced as the cause of these increasing peak flows, so the impact of continued municipal growth on peak flows should be addressed with flood planning.

As part of flood management, 17 small lakes or reservoirs exist in the watershed (Figure 2-2). These small lakes and reservoirs aid with flood management. Impoundment also improves water quality by reducing sediment and other pollutants through settling and with bacteria, allowing more time for decay to occur. Indications are that these small water bodies do not discharge into the creek except during large storm events (Wolfe, 2014), but aging of these structures is a concern. Fourteen of these reservoirs were built in the 1950s and 60s as flood control structures by the Soil Conservation Service (SCS, now NRCS), and all these flood control reservoirs are now under the control of local sponsors who have responsibility for operation and maintenance. Rehabilitation may be needed as these structures were designed for a minimum sediment storage of 50 years and components of the dam could be subject to failure due to aging. As these structures fill with sediment, they have less storage area for flood control, and their benefits in mitigating water quality also decrease. Because these aging structure may not be as effective as they once were, they could also potentially become a hazard increasing in flooding downstream if rehabilitation is not addressed (Featherston, 2009). The Nolan Creek Partnership, thus, supports assessment and rehabilitation, as needed, of these structures.

Of the SCS reservoirs, Bell County WCID No. 6 operates and maintain 13 of these dams. In 2007, Site 15 was rehabilitated with federal funding in part provided through NRCS. The match cost-share of 35 percent was provided by the WCID No. 6 as \$400,000 cash and the rest in in-

kind services represented by 40,000 cubic yards of topsoil for the auxiliary spillway (Featherston, 2009). Assuming 65 percent funding from the federal government, overall rehabilitation costs for Site 15 were over one million dollars. While many SCS flood control reservoirs have private sponsors making the costs of rehabilitation a significant barrier, as a taxing entity, WCID No. 6 has the ability to obtain notable amounts of cash to aid with rehabilitation efforts. Even when funding is available, it still takes time for rehabilitation to occur due to the need for technical expertise and planning. In discussions with a WCID No. 6 representative, they are working to rehabilitate Site 12 and planning efforts are under consideration for Sites 2, 3, and 5a with about a five year planning horizon.

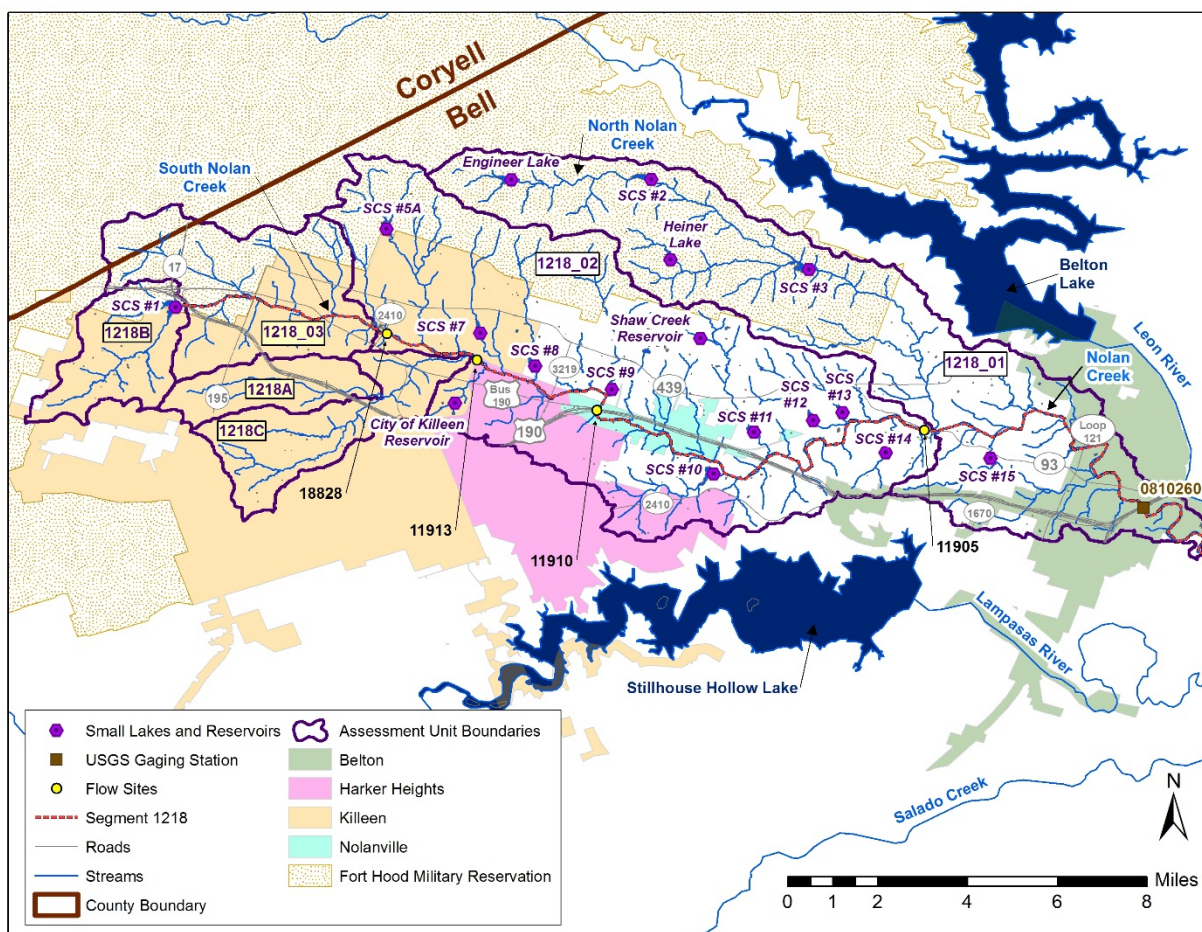


Figure 2-2 Location of hydrologic features within the Nolan Creek/South Nolan Creek watershed.

WAP Management Measures:

- Support ongoing flood planning and, as part of adaptive management, support and, as appropriate, integrate outcomes from the flood planning process, particularly the development of bioswales, detention or bio-retention ponds for flood management, into the WAP.
- Support ongoing assessment and rehabilitation efforts associated with small lakes and flood control reservoirs within the watershed.

Microbial Source Tracking

On various occasions stakeholders have expressed frustration in defining control measures for bacteria when they do not clearly know the source. How can we decrease bacteria if we do not know the source? How can we develop a plan when we do not know what we are after? While nonpoint source pollution impacting Nolan Creek is by definition from a multitude of sources, the use of Microbial Source Tracking (MST) would aid in better targeting the nonpoint sources needing management.

To aid in better focusing management measures, the stakeholder group recommends MST be implemented in the watershed as part of the management measures. The focus would be on identifying if bacteria are they primarily from human, pets, wildlife, or livestock in various subbasins. These data would then be used as an adaptive management tool, in that the new information provided through MST may reprioritize implementation measures. Costs for MST are variable depending on the number of samples analyzed and the precision desired in estimating relative sources. A rough cost of \$250,000 is estimated for MST, which would be in addition to the costs associated with general effectiveness monitoring.

Management Measures:

- Locate funding for MST.
- Complete MST.
- Analyze and present MST results and evaluate management measures in light of MST findings.

Associated Nutrient Reductions

As nutrient criteria for streams emerge within Texas, a larger focus may be needed in reducing nutrient contributions. Nutrients within Nolan Creek largely are contributed from point sources related to WWTF discharges (McFarland and Adams, 2015a). Implementing greater nutrient control from these WWTFs will be quite costly. Estimated costs for nutrient control, particularly for phosphorus, will vary depending on the reduction limit set with estimated capital costs of one million dollars or more for each facility (see http://t-nn.tarleton.edu/docs/nolan_creek/January%2016,%202014/Nolan-Creek---StatewideNutrientStandards-011614.pdf).

Many of the practices defined for reducing bacteria will also aid in reducing nutrient contributions to Nolan Creek from nonpoint sources. If more is needed to address nonpoint source nutrient contributions, a specific focus in urban areas would be to reduce use of lawn fertilizers by homeowners and commercial users, such as golf courses. Management practices may include:

- Educational outreach to homeowners, golf courses, and landscape operations on proper application and amounts of fertilizer for lawn needs.
- Encouraging the use of fertilizer containing only nitrogen, no phosphorus.

Similarly for rural areas, nutrient management from nonpoint sources should focus on reducing the fertilizer applied, whether commercial or organic, to the nutrients needed by the pasture or

cropping system. Cropland and improved pasture comprise only about three percent of the watershed area in Nolan Creek. Most of the rural area is rangeland or forest, which is not normally fertilized, except through direct deposition of organic fertilizer via livestock and wildlife. Within rural areas, producers should be encouraged to work with NRCS, the TSSWCB, and local SWCD in nutrient management planning as part of WQMPs and conservation plans.

SECTION 3

Educational Outreach

Educational outreach will be a part of all management measures, but for many measures, educational efforts can be grouped into regional, urban, and rural focus areas. One item specific to education is marketing. The stakeholder group indicated that different communication strategies may be needed for different management practices, particularly in targeting younger individuals. Items, such as brochures, fliers, factsheets, participation with informational booths at local events, and newsletters, reach only a portion of the target audience and even websites do not necessarily reach the technologically savvy. Use of a variety of social media techniques may be needed to address the educational component of the WAP. At a minimum, the watershed coordinator, noted in the next section under needed assistance for the Nolan Creek/South Nolan Creek watershed, should go through social media training to learn how to best target educational messages. If funding allows, a marketing expert or firm might be hired to aid in developing a strategized media outreach program.

Regional Programs

Regional programs focus on the watershed as a whole and include activities, such as maintaining a website for the Nolan Creek WPP for posting newsletters, educational fact sheets, training information, monitoring data, and other relevant information. A goal would be to link the educational component of this website with other pertinent websites providing information already developed, such as EPA's stormwater (<https://www.epa.gov/npdes/npdes-stormwater-program>) and nonpoint source (<https://www.epa.gov/nps>) programs, the information provided by various SWMPs in the watershed, and the CTCOG flood management planning and hike/bike trail information as well as other programs noted below.

Texas Watershed Stewards

The Texas Watershed Steward program implemented through a partnership between Texas A&M AgriLife Extension Service and TSSWCB provides science-based, watershed education to help citizens identify and take action to address local water quality impairments. Texas Watershed Stewards learn about the nature and function of watersheds, potential impairments, and strategies for watershed protection. A Texas Watershed Stewards Program was hosted in the Nolan Creek watershed on September 19, 2013, to encourage stakeholder participation in the watershed planning process. The program was open to all watershed residents including homeowners, business owners, agricultural producers, decision-makers, community leaders, and other citizens. The Nolan Creek Partnership found success in this program, and with cooperation from Texas A&M AgriLife Extension Service would like to provide the opportunity for this program to be presented again in the watershed at least once within the next three years and again within seven to ten years. Costs for presentation of this program are largely underwritten by TSSWCB as a program sponsor.

- Texas A&M AgriLife Extension Service and TSSWCB <https://tw.s.tamu.edu/>

Texas Stream Team

The Texas Stream Team is a volunteer water quality monitoring program coordinated through the Meadows Center for Water and the Environment at Texas State in San Marcos, Texas. The Texas Stream Team program trains volunteers in water quality monitoring and quality assurance procedures, so collected data may be used to augment professionally collected data. The Texas Stream Team was established in 1991 and is administered through a cooperative partnership between Texas State University, TCEQ, and EPA with assistance from other partners and sponsors. Five Texas Stream Team monitoring stations exist in the watershed, but commitments to monitoring at these five locations have varied with the most recent data from 2015 as noted on the Texas Stream Team website when checked in November 2017. The Nolan Creek Partnership would like to encourage more volunteers by facilitating training sessions in the watershed and also using data collected by volunteers to help better target sources of bacteria within the watershed. While training is often provided free of charge via the Texas Stream Team program, sponsors are solicited to aid with the cost of kits.

- Meadows Center for Water and the Environment – Texas Stream Team
<http://www.meadowscenter.txstate.edu/Service/TexasStreamTeam.html>
 - Costs: Water Quality Monitoring Kits – Standard Kit about \$500 each; Advanced Kit for Nitrate, Phosphorus & Turbidity about \$600; *E. coli* Monitoring Equipment about \$220 each (Total \$1,320 per volunteer for monitoring kits)

On-Site Sewage Facilities

In a survey of potential bacteria and nutrient sources in the Nolan Creek/South Nolan Creek watershed, OSSFs often referred to as septic systems, were identified as a potential source (McFarland and Adams, 2015b). The analysis of monitoring data and land-use information further targeted areas along Little Nolan Creek within the City of Killeen where many residences are not yet connected to the municipal sewer collection system (McFarland and Adams, 2015c; Nett and Flowers, 2008). Rural residences outside of sewer collection areas, particularly those nearest the creek, were also considered potential sources as the soils in the area are not well suited for OSSFs (Huckabee, et al., 1977). Efforts discussed below are educational components that are on-going or that the Nolan Creek Partnership can help provide to stakeholders on proper maintenance and repair of OSSFs.

OSSF Informational Campaign

Texas A&M AgriLife Extension and many other agencies have developed extensive educational programs geared towards homeowners with OSSFs. The Nolan Creek Partnership will adapt if needed and distribute existing technical guidance for owning and operating OSSFs. Distribution of this information should target those with OSSFs through direct mailings, service providers for OSSFs, and the Bell County Health Inspectors office, as the responsible entity for permitting and inspection of OSSFs. Other distribution mechanisms will also be considered as marketing for all management practices is developed.

Cost Estimate: Mailings an estimated 2,200 households with OSSFs (\$2,000)

The Nolan Creek Partnership website will link to online information available from the following:

- Texas A&M AgriLife Extension Service on On-Site Sewage Facilities – <https://ossf.tamu.edu/> and
- EPA – <https://www.epa.gov/septic>

OSSF Maintenance Workshops

The Nolan Creek Partnership plans to work with Texas A&M AgriLife Extension to host a one-day, educational workshop focused on the operation of aerobic and anaerobic septic systems including proper maintenance and repair at least once per year. Besides workshop delivery on maintenance targeting those who use OSSFs, Texas A&M AgriLife Extension also provides programs specifically for installers and maintenance providers that should also be delivered in the watershed at least once in the first three years. These workshops would focus primarily on those within rural areas of the watershed, as the cities within their MS4 stormwater management plans have outreach efforts focused on OSSFs. The cost of workshop delivery is often underwritten by other water quality programs promoting proper OSSF maintenance at the state level. If not underwritten, costs of sponsoring such a workshop are estimated at about \$3,500.

Online Onsite Wastewater Treatment and Reuse Course will be promoted on the Nolan Creek Partnership website.

- Texas A&M AgriLife Extension Service on On-Site Sewage Facilities – <https://water.tamu.edu/events-classes-training/>

Riparian and Stream Ecosystem Education Program

The Riparian and Stream Ecosystem Education Program will focus primarily on landowners along the creek, but also solicit participation from city/county personnel and developers. This program has been developed by the Texas Water Resources Institute (TWRI) with funding from EPA and TSSWCB and includes a large number of partners (e.g., TPWD, Texas Riparian Association, NRCS, the Nueces River Authority, Texas A&M AgriLife Research and Extension, and the Texas Tech University Llano River Field Station). The Nolan Creek Partnership will work with TWRI and the Texas Riparian Association to coordinate delivery of a program on Riparian Proper Functioning Condition at least once every three years. Through this program, the Nolan Creek Partnership hopes to connect riparian landowners with the Texas Riparian Association as a venue for learning more about the technical and financial resources available for improving management of their riparian lands. Riparian degradation is a major threat to stream health through its negative impacts on water quality and stream habitat. Proper management, protection, and restoration of riparian areas will help decrease bacteria, nutrient, and sediment loadings from nonpoint source runoff by allowing the floodplain to act as a buffer before runoff reaches the creek. The Riparian and Stream Ecosystem Education program will increase stakeholder awareness, understanding, and knowledge about the nature and function of riparian zones and the best management practices (BMPs) that can protect riparian areas, while minimizing nonpoint source pollution.

Cost: Delivery of Riparian and Stream Ecosystem Program has been underwritten by program sponsors. Free delivery of this program is contingent on continued sponsored funding.

- Texas Riparian Association – Riparian Program <http://texasriparian.org/riparian-education-program/> and <http://texasriparian.org/trainings/>

Urban Programs

The Nolan Creek Partnership through the Watershed Coordinator will collaborate with local cities and the county in the development and distribution of education and outreach materials focusing on urban nonpoint source pollution. As noted earlier, many of these urban programs and materials are associated with MS4 permits, so the Nolan Creek Partnership will coordinate with SWMP educational efforts in these activities (see Appendix D). Examples of activities that the Nolan Creek Partnership would promote and expand upon include advertising and support of community stream cleanup events, efforts to control pet waste, and hazardous waste cleanup days. These urban programs will enable the Nolan Creek Partnership to reach residents, visitors, businesses, as well as city/county personnel and developers.

An example of educational outreach already occurring regarding safe use of the creek is the webpage on the Belton City website on Nolan Creek (http://www.beltontexas.gov/departments/parks_and_recreation/nolan_creek.php). This webpage includes access to rain gages and stream elevation monitors at locations along the creek from Killeen to Belton allowing individuals to view current water levels as well as the impact of recent rains on stream conditions. The Belton website also includes a page dealing with Frequently Asked Questions about Nolan Creek (http://www.beltontexas.gov/departments/parks_and_recreation/faqs_about_nolan_creek.php). Many of these questions focus on access for tubing or kayaking but also the safety of recreating in Nolan Creek. For water quality information, the Belton Nolan Creek website also includes links to data from TCEQ and the Nolan Creek WPP. The Nolan Creek WPP website would reciprocate with links to the City of Belton website on Nolan Creek.

Sewer Lines – Private Infrastructure

A primary focus identified for education dealing with human waste was the lateral lines linking individual homes to the main WWTF collection system. The Nolan Creek WAP will expand on efforts already being conducted under MS4 permit SWMPs through the Nolan Creek WPP website as well as other educational avenues. This is an area where how best to market the information still needs to be defined, but the focus would be on the following:

- Education of private property owners on responsibilities regarding lateral lines
- Education of owners and renters on how to maintain clear lateral lines
- Education of owners and renters on how to identify leakage or blockage problems with lateral lines for wastewater located on private property and what to do when problems occur

Texas Waterway Cleanup Program

The Nolan Creek Partnership plans to coordinate with Keep Texas Beautiful to organize yearly a creek cleanup within the watershed. The creek cleanup will be open to all stakeholders, and local civic groups will be invited to participate. The Watershed Coordinator will also promote and participate in other creek cleanup events as a way to connect stakeholders to the creek and the watershed as well as providing a conduit for distributing educational information.

Low Impact Development

The Watershed Coordinator should plan for at least one workshop/training on LID within the watershed at least once every three years. Dr. Fouad Jaber of the Texas A&M AgriLife Extension Service Dallas Center should be contacted regarding delivery of these workshops. Several demonstration projects for LID practices have been designed and installed at the Texas AgriLife Research and Extension Center in Dallas including permeable pavements, bioretention, rainwater harvesting, green roofs, and detention ponds. Dr. Jaber has been the lead extension specialist involved with measuring the effectiveness of these LID practices in reducing stormwater runoff volume and pollutant loads. These demonstration projects provide examples of how LID can be integrated into the design of new developments or retrofitted to existing area. This educational outreach may involve having Dr. Jaber speak locally, but also may involve travel to the Texas AgriLife Research and Extension Center in Dallas to view demonstration sites. If a workshop cannot be coordinated with Dr. Jaber, the watershed coordinator should seek out others involved with LID.

Domestic Pet Waste

Pet Waste Management

Pet waste has been identified in many watersheds as a major contributing source of bacteria, particularly in urban areas. Municipalities in the watershed have developed programs geared towards pet owners regarding proper pet waste management, but consensus was that more needs to be done. A large amount of educational information is available regarding the impacts of pet waste on water quality from EPA and other resources. The Nolan Creek Partnership will work with existing programs to help develop and distribute existing materials about the effects of pet waste on water quality through newsletters and other venues. The Nolan Creek Partnership will also work to develop a watershed-wide pet waste campaign to encourage folks to pick up pet waste.

Pet Stations

The Nolan Creek Partnership will encourage municipalities within the watershed to add “pet stations” at local parks along Nolan Creek and South Nolan Creek. The “pet station” contains all the elements necessary to maximize clean up success with waste pick up baggies as well as a trash receptacle. A watershed friendly sign could be attached to the pet waste station noting pet waste as a contributing source of bacteria in the watershed. These pet waste stations require continuous maintenance, so engagement of municipalities will be a necessity.

Wildlife Waste

While not considered a major source of bacteria in the watershed, waterfowl and other wildlife can become a problem source if population levels are not kept under control. Working with TPWD, educational outreach will include information on why the public should be discouraged from feeding waterfowl and small mammals. Signage in parks to discourage wildlife feeding should be adopted by municipalities.

Home Chemical & Hazardous Waste Collection Events

Several entities host HHW events within or near the watershed that provide respective residents a place to properly dispose of hazardous chemicals. All too commonly typical household chemicals, such as fertilizers, pesticides, herbicides, insecticides, and cleaning supplies are

improperly disposed. When improperly disposed of, these chemicals and hazardous waste can eventually make their way into local waterways (Nolan/South Nolan Creek) through stormwater runoff. The Home Chemical & Hazardous Waste Collection Events provide an easy and safe method for the proper disposal of the more harmful household products. The Nolan Creek Partnership will help promote such events as part of its outreach activities and aid in providing information on how to appropriately deal with hazardous waste through its website and other venues.

Agricultural Programs

There is an abundance of material already developed that focuses on the control of bacteria and nutrients from agricultural sources. The Nolan Creek Partnership will coordinate with the county, NRCS, TSSWCB, Texas A&M AgriLife Extension, and other agencies to modify and distribute education and outreach materials that target the rural stakeholders and livestock owners in the watershed. Examples of activities that the Nolan Creek Partnership will encourage include nutrient management, soil and water testing, and livestock grazing management; all items currently addressed by Texas A&M AgriLife Extension. The Nolan Creek Partnership will also promote and host agricultural programs to encourage action by rural and urban livestock owners in appropriate management of animal waste.

Lone Star Healthy Streams Program

The Lone Star Healthy Streams (LSHS) program focuses on educating rural livestock owners on practices to reduce bacteria in Texas water bodies through best management practices for livestock. The LSHS program was developed by Texas A&M AgriLife Extension Service and the Texas Water Resources Institute. Presentations/workshops can be arranged upon request or the program can be accessed through a series of online courses at: <https://water.tamu.edu/events-classes-training/> . These presentations/workshops are designed to target audiences for beef cattle, dairy cattle, feral hogs, horses, and poultry. For the Nolan Creek watershed, beef cattle and horses would be the primary focus and potentially feral hogs, should the hog problem increase. Through the Lone Star Healthy Stream program, resources are provided that specifically address best management practices for reducing bacteria from livestock, such as waste utilization, filter strips, and access control (<http://lshs.tamu.edu/bmps/>). The Nolan Creek Partnership would encourage stakeholders to access these on-line educational modules through brochures, fliers, newsletters, and other awareness and informational materials.

- Texas A&M AgriLife Extension Service LSHS Program <https://water.tamu.edu/water-quality/lone-star-healthy-streams-program-lshs/>

Feral Hog Management Workshop

The Nolan Creek/South Nolan Creek watershed is primarily urban and feral hogs are not considered a major problem or source of bacteria in this watershed. However, it has been expressed by stakeholders that in the more rural areas, particularly along North Nolan Creek, feral hogs can be a problem. More recently, hog damage has been noted along the creek within the city limits of Harker Heights. The Nolan Creek Partnership, in conjunction with Texas A&M AgriLife Extension and other appropriate agencies will make available educational materials on hog management. Hog management is a significant issue in some of the surrounding watersheds, such as the Lampasas and Leon River watersheds that are more rural, and as workshops on Feral

Hog Management are presented for these other watersheds, the Nolan Creek Partnership will help to promote these as well as conduct a workshop specific to the watershed at least once every three years. These Feral Hog Workshops present information on feral hog biology, effects feral hogs have on water quality, trap design as well as pertinent laws and regulations. Costs for Feral Hog Workshops can be variable depending on current support from statewide programs.

Online information on feral hog control is also available from the following:

- Texas A&M AgriLife Extension – Coping with Feral Hogs <https://feralhogs.tamu.edu/> and Feral Hogs http://articles.extension.org/feral_hogs .
- TPWD – Feral Hogs https://tpwd.texas.gov/huntwild/wild/nuisance/feral_hogs/

Table 3-1 Summary of proposed educational outreach activities.

Education or Outreach Activity	Responsible for Delivery	Number to be Implemented			Estimated Cost	Goal
		Years 1-3	Years 4-6	Years 7-10		
Nolan Creek WPP - Awareness and Informational Materials						
Website, other Social Media, and email	Watershed Coordinator ¹	Maintained throughout	Maintained throughout	Maintained throughout	About \$250/yr to host	Provide a base for electronically available educational materials and outreach to stakeholders throughout the watershed
Fact Sheet (General for the WPP)	Watershed Coordinator	1 per yr	1 per yr	1 per yr	About \$40/ fact sheet (100 copies)	Distribute at least 100 copies per year via public locations, such as libraries and city/county offices, and make electronically available
Newsletters	Watershed Coordinator	2 per yr	2 per yr	2 per yr	Electronic only	Updates once every six months
Brochures	Watershed Coordinator	1 per yr	1 per yr	1 per yr	About \$40 each (100 copies)	Distribute at least 100 copies per year via public locations, such as libraries and city/county offices, and make electronically available
Fliers	Watershed Coordinator	4 per yr	4 per yr	4 per yr	About \$20 each (100 copies)	Distribute at least 100 copies per year via public locations, such as libraries and city/county offices, and make electronically available
Displays at Local Events	Watershed Coordinator	4 per yr	4 per yr	4 per yr	\$500 to set up initial display and then \$100/yr for updates	Watershed Coordinator should participate in at least 4 events per year

Watershed Action Plan for the Nolan Creek/South Nolan Creek Watershed

Education or Outreach Activity	Responsible for Delivery	Number to be Implemented			Estimated Cost	Goal
		Years 1-3	Years 4-6	Years 7-10		
Regional Educational Programs						
Texas Watershed Stewards	Texas A&M AgriLife Extension Service	1		1	Delivery cost underwritten but sponsor for lunch for up to 50 participants (about \$600)	One in first three years and another in years 7-10
Texas Stream Team	Meadows Center for Water and the Environment	1 per yr	1 per yr	1 per yr	Kits about \$1,320/volunteer	Recruit 10 volunteers initially and then at least 2 per year to account for turnover
OSSF Maintenance Workshops for Users	Texas A&M AgriLife Extension Service	1 per yr	1 per yr	1 per yr	About \$3,500/workshop and about \$3,000 for direct mailings to those on OSSFs	Conduct one workshop per year with at least 20 attendees/workshop
OSSF Maintenance Workshops for Installers & Maintenance	Texas A&M AgriLife Extension Service	1	1	1	About \$3,500/workshop	Conduct one workshop every three years with at least 5 attendees/workshop
OSSF Information Campaign	Watershed Coordinator, Municipalities & Bell County	Link to available electronic information on website & include with workshop mailings to those on OSSFs			Include with workshop mailing (about \$1,000 for copies of information)	Reach at least 50% of OSSF users with mailings
Riparian and Stream Ecosystem Education Program	Texas Riparian Association – Riparian Program	1	1	1	Cost underwritten by program sponsors	Conduct one workshop every three years with at least 15 attendees/workshop

Watershed Action Plan for the Nolan Creek/South Nolan Creek Watershed

Education or Outreach Activity	Responsible for Delivery	Number to be Implemented			Estimated Cost	Goal
		Years 1-3	Years 4-6	Years 7-10		
Urban Programs						
Sewer Lines - Private Infrastructure Educational Campaign	Municipalities with Watershed Coordinator	Maintained throughout	Maintained throughout	Maintained throughout	Cost largely covered as time of watershed coordinator, plus additional \$5,000 per year for campaign	Link to electronic information available dealing SWMPs & support relevant activities
Texas Waterway Cleanups	Keep Texas Beautiful	1 per yr	1 per yr	1 per yr	About \$2,000 per event, but often sponsored	Participate in at least one creek clean up per year
LID Workshops	Texas A&M AgriLife Extension (or other LID experts)	1	1	1	Depends on delivery method and if travel to Dallas is needed.	Sponsor at least one workshop every three years
Pet Waste Management Educational Campaign	Municipalities with Watershed Coordinator	Maintained throughout	Maintained throughout	Maintained throughout	Cost largely covered as time of watershed coordinator, plus additional \$10,000 per year for outreach	Link to electronic information available dealing SWMPs & support relevant activities
Pet Waste Stations and Signage	Municipalities	1	1	1	Stations about \$650 each, maintenance about \$100/station per yr, signage about \$250/sign	Add three stations per year
Don't Feed Wildlife Education	Municipalities	1			Signage in parks near creek, \$250/sign	Add three signs in first three years and educational materials provided through electronic media

Watershed Action Plan for the Nolan Creek/South Nolan Creek Watershed

Education or Outreach Activity	Responsible for Delivery	Number to be Implemented			Estimated Cost	Goal
		Years 1-3	Years 4-6	Years 7-10		
HHW Events	Municipalities, CTCOG & Bell County	1 per yr	1 per yr	1 per yr	About \$12,500 per event, but often sponsored	Participate in at least one HHW event per year
Support SWMP Educational programs	Municipalities, Fort Hood & Bell County	Maintained throughout	Maintained throughout	Maintained throughout	Cost largely covered as time of watershed coordinator	Link to electronic information available dealing SWMPs & support relevant activities
Agricultural Programs						
Lone Star Healthy Streams Program (Cattle)	Texas A&M AgriLife Extension Service LSHS Program	1	1	1	Cost underwritten by program sponsors	Conduct one workshop every three years with at least 15 attendees/workshop
Lone Star Healthy Streams Program (Horses)	Texas A&M AgriLife Extension Service LSHS Program	1	1	1	Cost underwritten by program sponsors	Conduct one workshop every three years with at least 15 attendees/workshop
Feral Hog Management Workshops	Texas A&M AgriLife Extension Service	1	1	1	Advertise electronically, cost variable depending on program support	One every three years
Feral Hog Education	Watershed Coordinator	Maintained throughout	Maintained throughout	Maintained throughout	Time for watershed coordinator	Make available already existing educational materials through website and other electronic media

1. Cost of Watershed Coordinator estimated at \$70,000 per year.

SECTION 4

Financial and Technical Assistance

Watershed Coordinator

To coordinate activities within the Nolan Creek WPP, the Nolan Creek Partnership recommends hiring a locally-based Watershed Coordinator. Primary Duties of the Watershed Coordinator would be as follows:

- Work with the county, cities, local boards, and businesses to coordinate implementation of management measures.
- Coordinate educational outreach activities by
 - Developing publications (newspaper, newsletter, factsheets) and website content to promote and communicate watershed efforts
 - Interacting with appropriate state and federal agencies to set up workshops
 - Promoting and participating in creek cleanup and HHW activities and, as appropriate, organizing such events
- Engage state and federal agencies and organizations, as appropriate, in introducing needed technical and financial resources to stakeholder groups.
- Aid in developing grants to obtain financial resources to implement educational and management practices.
- Track and document implementation efforts to assess progress toward established goals.
- Assist in developing a water quality monitoring effectiveness program, including MST, and participate with monitoring and data management, as needed.
- Evaluate water quality data to monitor progress towards instream improvements.
- Conduct regular stakeholder meetings to provide updates on progress and seek input on activities and assess the need for new approaches.

Cost – Salary \$35,000 to \$50,000 plus about 32% fringe (total \$46,200 to \$66,000/year) with an additional \$5,000 per year estimated for travel and general expenses. Source of funding likely through municipalities with financial assistance through the Clean Water Act (CWA) 319 program (CWA 319 funding needs 40% match from non-federal dollars).

Technical Assistance

Most management measures will require some level of technical assistance to properly implement. A variety of technical resources are available, many providing planning assistance free of charge, through state and federal agencies. Several of the resources listed below are also listed as educational resources. The Watershed Coordinator for the WPP should be capable of facilitating technical assistance with these entities. Of note, programs listed are subject to change, particularly with variations in state and federal funding.

Wastewater Treatment Facilities

- TCEQ – Help for Wastewater Treatment Plant Owners and Operators (<https://www.tceq.texas.gov/assistance/water/wastewater/help-for-wastewater-treatment-plant-owners-and-operators>)
- EPA – Municipal Wastewater (<https://www.epa.gov/npdes/municipal-wastewater>)
- Brazos River Authority (BRA) – operates Temple-Belton WWTF and can provide technical assistance to other operations in the area (<http://www.brazos.org/About-Us/Water-Quality/Water-Wastewater-Treatment>)
- Municipalities, WCID1 & WCID 3

Sewer Line Infrastructure

- Municipalities – Public Works Departments
- TCEQ – Sanitary Sewer Overflow Initiative (<https://www.tceq.texas.gov/compliance/investigation/ssoinitiative>)
- EPA – Municipal Wastewater (<https://www.epa.gov/npdes/municipal-wastewater>)

OSSFs

- Bell County Health Department – On-Site Sewer Facilities Information – Inspections and Permits (http://www.bellcountyhealth.org/environmental_health_and_food_protection/on-site_sewer_facilities/index.php)
- Texas AgriLife – Onsite Waste Water Treatment Systems (<https://water.tamu.edu/water-quality/onsite-waste-water-treatment-systems/>)
- TCEQ – On-Site Sewage Facilities (Septic Systems) (<https://www.tceq.texas.gov/permitting/ossf>)
- EPA – Septic Systems (Onsite/Decentralized Systems) (<https://www.epa.gov/septic>)

Homeless

- TCEQ Brownfields Site Assessment Program – Could potentially be used to facilitate the cleanup and redevelopment of areas where homeless encampments have become a hazard to the environment (<https://www.tceq.texas.gov/remediation/bsa/Benefits.html>)
- Homeless shelters and charitable organizations working with the homeless within the watershed, such as Families in Crisis and the Central Texas Homeless Alliance.

Pet Waste

- Municipalities
- Existing Pet Waste Campaigns – Examples:
 - City of Austin, Texas, Scoop the Poop (<http://www.austintexas.gov/department/scoop-the-poop>)
 - New Hampshire Department of Environmental Services, Pet Waste Outreach Campaign (https://www.des.nh.gov/organization/divisions/water/wmb/coastal/scoop_the_poop.htm)
 - Metropolitan North Georgia Water Planning District (<http://cleanwatercampaign.org/protect-our-water/pet-waste/>)

- Pet Poo Skiddoo, Pet Waste Removal (<https://www.petpooskiddoo.com/blog/10-bizarre-campaigns-pushing-people-to-pick-up-dog-poop/>)

Illegal Dumping

- TCEQ – "Don't Mess with Texas Water": A Way to Report Illegal Dumping (<https://www.tceq.texas.gov/p2/dont-mess-with-texas-water-a-way-to-report-illegal-dumping#get-involved>)
- Bell County - Illicit Discharge Detection and Elimination (http://www.bellcountytexas.com/departments/engineer_2/illicit_discharges.php) and County Engineer's Office at (254) 933-5275
- Municipalities

Urban Stormwater Management

- EPA – National Pollutant Discharge Elimination System (NPDES), Stormwater Discharges from Municipal Sources (<https://www.epa.gov/npdes/stormwater-discharges-municipal-sources>)
- TCEQ – Municipal Separate Storm Sewer System (MS4) Discharges: Am I Regulated? (https://www.tceq.texas.gov/permitting/stormwater/ms4/WQ_ms4_AIR.html)
- TPWD for all wildlife related management strategies – Hill County Wildlife District, Bell County (<https://tpwd.texas.gov/landwater/land/habitats/hillcountry/regulatory/?county=bell>)

Rural Stormwater Management

- NRCS – Conservation Planning (<https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/cp/>)
- USDA Belton Service Center, 1605 N Main St, Belton, TX, 76513-1944; Phone (254) 939-7808 ext 3 (<https://offices.sc.egov.usda.gov/locator/app?type=ref&state=48&county=027&agency=nrcs>)
- TSSWCB – Water Quality Management Plan (<https://www.tsswcb.texas.gov/programs/water-quality-management-plan>), Dublin Regional Office 611 East Blackjack, Dublin, TX 76446-2321; Phone 254-445-4814
- SWCD – Central Texas SWCD, PO Box 1832, Temple, TX 76503-1832; Phone (254) 718-5296; email: centraltexas@swcd.texas.gov
- Texas A&M Forest Service – Contact Us (<http://texasforests-service.tamu.edu/content/article.aspx?id=19988>)
- TPWD – Hill County Wildlife District, Bell County (<https://tpwd.texas.gov/landwater/land/habitats/hillcountry/regulatory/?county=bell>)
- Texas A&M AgriLife – Stormwater Management (<https://water.tamu.edu/water-management-irrigation/stormwater-management/>)

Roosting Birds

- TPWD – Hill County Wildlife District, Bell County (<https://tpwd.texas.gov/landwater/land/habitats/hillcountry/regulatory/?county=bell>)
- Texas Wildlife Services – Roosting Birds (<https://agrilife.org/twxwildlifeservices/species-information-and-publications/birds/roosting-birds/>)

Wildlife (including waterfowl)

- TPWD for all wildlife related management strategies – Hill County Wildlife District, Bell County
(<https://tpwd.texas.gov/landwater/land/habitats/hillcountry/regulatory/?county=bell>)
- Texas Wildlife Services (<https://agrilife.org/txwildlifeservices/>)

Recreational Use

- TPWD – Recreational Grants (<https://tpwd.texas.gov/business/grants/recreation-grants>)

Flood Management

- CTCOG – Nolan Creek Flood Protection Planning Study (<https://ctcog.org/regional-planning/nolan-creek-flood-protection-planning-study/>)
- Texas Floodplain Management Association (training) –
(http://www.tfma.org/events/event_list.asp)
- NRCS – Watershed Protection and Flood Prevention Program
(<https://www.nrcs.usda.gov/wps/portal/nrcs/main/tx/programs/planning/wpfp/>) provides assistance with flood control dam rehabilitation (example:
https://www.nrcs.usda.gov/wps/portal/nrcs/detail/tx/programs/planning/wpfp/?cid=nrcs144p2_002969)
- TSSWCB – Flood Control Dam Program (<https://www.tsswcb.texas.gov/programs/flood-control-program>)

Microbial Source Tracking

- TWRI – Texas Bacterial Source Tracking Program (<http://texasbst.tamu.edu/>); Dr George Di Giovanni, Division of Epidemiology, Human Genetics & Environmental Sciences, University of Texas School of Public – El Paso,
(HealthGeorge.D.DiGiovanni@uth.tmc.edu), Phone: (915) 747-8509 and Dr. Terry Gentry, Texas A&M AgriLife Research, Department of Soil and Crop Sciences, College Station, (tgentry@ag.tamu.edu), Phone: (979) 845-5323.
- United States Geological Survey (USGS) Microbial Source-Tracking and Detection Techniques (<https://water.usgs.gov/owq/microbial.html>) and Selection and
- EPA - Using Microbial Source Tracking to Support Total Maximum Daily Load (TMDL) Development and Implementation (<https://www.epa.gov/tmdl/using-microbial-source-tracking-support-tmdl-development-and-implementation>)

Instream Effectiveness Monitoring

- TCEQ – Clean Rivers Program (<https://www.tceq.texas.gov/waterquality/clean-rivers>)
- Brazos River Authority (BRA) – facilitates monitoring with TCEQ within the Brazos River Basin via the Texas Clean Rivers Program and works with WPPs for water quality improvement (<http://www.brazos.org/About-Us/Water-Quality>)
- The Meadows Center for Water and the Environment – Texas Stream Team
(<http://www.meadowscenter.txstate.edu/Service/TexasStreamTeam.html>)

Financial Assistance

While watershed municipalities, Fort Hood, and Bell County are likely to aid with financing many of these management measures, often budgets are already stretched thin, so financial assistance would aid in implementation of the measures outlined in this WAP. There are several sources of financial assistance, mainly from federal and state programs. While not exhaustive, sources of potential funding beyond county and municipal sources are listed below by agency along with the types of management measures that might be funded under each, which is also summarized at the end of this section (Table 4-1).

EPA

CWA §319 Nonpoint Source Grant Program

The CWA §319 Nonpoint Source program provides grant funding through TSSWCB and TCEQ from EPA to implement specific projects that control and abate nonpoint source pollution. The TSSWCB focuses on projects aimed at agricultural and silvicultural nonpoint source pollution and the TCEQ focuses on projects that target urban nonpoint pollution. Management measures that might be addressed with CWA §319 funding include support of a Watershed Coordinator as well as implementation of some management practices and educational outreach activities. Funding through the CWA §319 requires a 40 percent nonfederal match and funding cannot be used to support permitted activities, such as those specifically outlined within SWMPs under MS4 permits or direct discharge permits associated with WWTFs. For example, CWA §319 funding could be used to assist with the removal of OSSFs within a municipality but could not fund the connecting line to the central wastewater collection system. Another example is that CWA §319 funding could be used for educational outreach, such as for pet waste, which is more frequent, uses a different venue, or covers a broader area than addressed through SWMPs associated with MS4 permits. The TCEQ and/or TSSWCB should be contacted regarding appropriate use of CWA §319 prior to applying to make sure planned activities are an appropriate use of this funding.

- USEPA <https://www.epa.gov/lakes/clean-water-act-section-319>
- TCEQ <http://www.tceq.texas.gov/waterquality/nonpoint-source/grants/grant-pgm.html>
- TSSWCB <http://www.tsswcb.texas.gov/managementprogram>

Environmental Education Grants

Under the Environmental Education (EE) grants program, EPA seeks to support environmental education projects that promote environmental awareness and stewardship and help provide people with the skills to take responsible actions to protect the environment. This grant program provides financial support for projects that design, demonstrate, and/or disseminate environmental education practices, methods, or techniques.

- EPA <https://www.epa.gov/education/environmental-education-ee-grants>

TCEQ

Supplemental Environmental Projects (SEPs)

As part of a settlement for an enforcement action, TCEQ may approve environmental projects as an offset to assessed penalties. For local governments, compliance SEPs may include repair on structures or equipment related to the cause of the violation or remediation efforts, such as

cleanup of a spill. Custom SEPs are open to a variety of respondents and can include projects, such as collection events for tires, HHW, electronics and/or large solid waste items; cleanup of illegal dump sites; erosion control projects along a creek; or extending first-time sewer service to low income residents utilizing faulty septic systems.

- TCEQ <http://www.tceq.texas.gov/legal/sep/>

Texas Clean Rivers Program

The Texas Clean Rivers Program (CRP) is a partnership between TCEQ and regional water authorities that conducts statewide water quality monitoring and assessment. The Nolan Creek/South Nolan Creek watershed is in the Brazos Basin with the Brazos River Authority (BRA) as the TCEQ partner. The CRP program is fee-funded through permits with most fees allocated to monitoring, quality assurance, and data management functions of the program. While this program does not provide grants or loans, its resources can be targeted to aid with effectiveness monitoring in the Nolan Creek/South Nolan Creek watershed to assess improvement in water quality conditions as management measures are implemented. Input on monitoring is solicited through the Brazos River Steering Committee, which meets annually allowing stakeholder involvement setting goals and priorities for development and allocation of CRP resources.

- TCEQ <http://www.tceq.texas.gov/waterquality/clean-rivers/> TCEQ,
- BRA <https://www.brazos.org/About-Us/Water-Quality/Clean-Rivers-Program>

Texas Department of Agriculture

Community Development Block Grant (CDBG)

The Texas CDBG Community Development Fund provides grants to rural Texas cities (under 50,000 in population) and counties (non-metropolitan population under 200,000), which are not eligible for direct CDBG funding from Housing and Urban Development. The Texas CDBG program provides for basic infrastructure projects such as water/wastewater facilities, street improvements, and drainage. Grants are competitive with applications accepted biennially.

- Texas Department of Agriculture (TDA)
[http://www.texasagriculture.gov/GrantsServices/RuralEconomicDevelopment/RuralCommunityDevelopmentBlockGrant\(CDBG\).aspx](http://www.texasagriculture.gov/GrantsServices/RuralEconomicDevelopment/RuralCommunityDevelopmentBlockGrant(CDBG).aspx)
- CTCOG – <https://ctcog.org/regional-planning/technical-assistance/>

Texas Capital Fund

The Texas Capital Fund Infrastructure/Real Estate Programs provide financial resources to non-entitlement communities. Funds from the infrastructure program can be utilized for public infrastructure, such as stormwater drainage, water and sewer lines, needed to assist a business. Funds from the real estate program are for real estate development to assist a business. Both programs focus on new business development and expansions that commit to creating and/or retaining permanent jobs, primarily for low and moderate-income persons.

Non-entitlement cities are located predominately in rural areas and are cities with populations less than 50,000 thousand persons; cities that are not designated as a central city of a metropolitan statistical area; and cities that are not participating in urban county programs. Non-

entitlement counties are also predominately rural in nature and are counties that generally have fewer than 200,000 persons in the non-entitlement cities and unincorporated areas located in the county. Businesses or individuals may not directly submit applications.

- Texas Department of Agriculture
[http://www.texasagriculture.gov/GrantsServices/RuralEconomicDevelopment/RuralCommunityDevelopmentBlockGrant\(CDBG\)/CDBGResources/Applications/INFRARE.aspx](http://www.texasagriculture.gov/GrantsServices/RuralEconomicDevelopment/RuralCommunityDevelopmentBlockGrant(CDBG)/CDBGResources/Applications/INFRARE.aspx)
and
<http://www.texasagriculture.gov/GrantsServices/RuralEconomicDevelopment/TexasCapitalFund.aspx>

TPWD

Texas Farm & Ranch Lands Conservation Program

The Texas Farm & Ranch Lands Conservation Program (F&RLCP), established by Senate Bill 1273 in 2005, provides grants to landowners to support responsible stewardship and conservation of working lands by generating interest and awareness in easement programs and other conservation options that aid in conserving the ecological and economic value of these lands. Originally under the Texas General Land Office, this program effective January 1, 2016, is now administered through the TPWD.

- TPWD <https://tpwd.texas.gov/landwater/land/private/farm-and-ranch/>

Landowner Incentive Program

The Texas Landowner Incentive Program (LIP) is a collaborative effort between TPWD Wildlife and Inland Fisheries Divisions to meet the needs of private, non-federal landowners wishing to enact good conservation practices on their lands for the benefit of healthy terrestrial and aquatic ecosystems. Partnerships with the U.S. Fish and Wildlife Service Partners for Fish and Wildlife Program, National Fish and Wildlife Foundation, and others fund LIP. Funding through LIP is competitive with highest priority given to projects expected to directly benefit Endangered Species Act (ESA)-listed species and their habitats. Special emphasis is placed on projects that benefit freshwater mussel species of conservation concern and pollinator species.

- TPWD <https://tpwd.texas.gov/landwater/land/private/lip/>

National Recreational Trails Fund

The TPWD administers the National Recreational Trails Fund (RTF) in Texas under the approval of the Federal Highway Administration. This federally funded program receives its funding from a portion of federal gas taxes paid on fuel used in non-highway recreational vehicles. The reimbursable grants can be up to 80% of project cost with a maximum of \$200,000 for non-motorized trail grants and a maximum award of \$400,000 for motorized (off-highway vehicle) trail grants. Funds can be spent on both motorized and non-motorized recreational trail projects such as the construction of new recreational trails, to improve existing trails, to develop trailheads or trailside facilities, and to acquire trail corridors.

- TPWD <https://tpwd.texas.gov/business/grants/recreation-grants/recreational-trails-grants>

Local Park Grant Program

The Local Park Grant Program administered by TPWD consists of five individual programs that assist local units of government with the acquisition and/or development of public recreation areas and facilities throughout the State of Texas. The Program provides 50% matching grants on a reimbursement basis to eligible applicants. All grant assisted sites must be dedicated as parkland in perpetuity, properly maintained and open to the public.

- TPWD <https://tpwd.texas.gov/business/grants/recreation-grants/about-local-parks-grants>

TSSWCB

Water Quality Management Plan Program

A WQMP is a site-specific plan for land improvement measures developed through SWCDs for agricultural and silvicultural lands. A WQMP provides farmers and ranchers a voluntary opportunity to achieve a level of nonpoint source water pollution prevention or abatement consistent with state water quality standards. Through a partnership with SWCDs, the TSSWCB, and NRCS, free technical assistance is provided to landowners to develop a WQMP. Financial assistance is available from TSSWCB to assist landowners in implementing certain conservation practices in WQMPs.

- TSSWCB <http://www.tsswcb.texas.gov/en/wqmp>

Flood Control Program Operation and Maintenance Grant Program

This TSSWCB program provides state dollars to flood control dam sponsors for operation and maintenance on a first-come-first-serve basis with reimbursement up to 90 percent of costs. Funding can be used for structural repair, matching funds from federal rehabilitation projects or Emergency Watershed Protection Program repairs, and/or engineering services.

- TSSWCB <https://www.tsswcb.texas.gov/programs/flood-control-program>

Water Supply Enhancement Program

The TSSWCB is designated as the agency responsible for administering the Texas Brush Control Program with the purpose of increasing available surface and ground water through the targeted control of brush species that are detrimental to water conservation (e.g., juniper, mesquite, saltcedar). The Water Supply Enhancement Program (WSEP) can provide grant funding to brush control projects, but WSEP funds can only be allocated to projects that have a published feasibility study that includes a watershed-specific computer-modeled water yield component developed by a person with expertise as described in Texas Agriculture Code §203.053(b). For a watershed to be considered eligible for cost-share funds, the feasibility study must demonstrate increases in post-treatment water yield as compared to the pre-treatment conditions.

- TSSWCB <https://www.tsswcb.texas.gov/programs/water-supply-enhancement-program>

TWDB

Clean Water State Revolving Fund Loan Program

Authorized by the Clean Water Act with funds managed by the TWDB via EPA, the Clean Water State Revolving Fund (CWSRF) Loan Program provides low-cost financial assistance for planning, acquisition, design, and construction of wastewater, reuse, and stormwater

infrastructure (<https://www.epa.gov/cwsrf> and <http://www.twdb.texas.gov/financial/programs/CWSRF/>). The CWSRF program traditionally have been used for upgrading WWTFs and collection systems in that it can provide the significant funding often needed for these large infrastructure projects. In dealing with nonpoint source abatement and stormwater drainage, the CWSRF can also be used for “soft” structures, such as ponds, bioswales, and green infrastructure as well as “hard” drainage structures, such as pipes and concrete channels. Other types of eligible activities include acquisition, protection and/or rehabilitation of natural waterways and implementation of LID or other stormwater best management practices. Eligible applicants for the CWSRF include cities, counties, districts, river authorities, designated management agencies, authorized Indian tribal organizations, and public and private entities proposing nonpoint source or estuary management projects. For entities without a dedicated source of revenue to repay loans, sponsorship may be a strategy to consider for less traditional types of water quality improvement projects (see EPA and USDA Forest Service National Urban Forest Technology & Science Delivery Team webinar <https://www.epa.gov/cwsrf/cwsrf-webinars>).

- TWDB <http://www.twdb.texas.gov/financial/programs/cwsrf/>

Economically Distressed Area Program

Funding through Economically Distressed Area Program (EDAP) is designed to provide assistance to economically distressed areas where water or wastewater services do not exist or systems do not meet minimum state standards. This potentially could be a source of funding in considering improvements for connections to the wastewater collection system within municipalities or improvement of systems within county subdivisions for economically disadvantaged neighborhoods within the watershed. There are several special requirements associated with EDAP funding, most notably that the median household income be less than 75 percent of the median state household income and that the area was established as a subdivision prior to June 1, 2005. Areas would need to be carefully targeted and TWDB should be consulted to make sure the full listing of special requirements is met prior to pursuing this funding. Funding through EDAP is available in the form of a grant or a combination grant/loan for qualified areas needing water and wastewater infrastructure services or improvements.

- TWDB http://www.twdb.state.tx.us/assistance/assistance_main.asp TWDB

Agricultural Water Conservation Loan Program

The Agricultural Water Conservation Loan (AWCL) Program provides low-interest, fixed-rate loans to state agencies and political subdivisions for water conservation projects. These funds may also provide pass-through loans to individuals for water conservation projects. The AWCL program also provides a linked deposit loan program for individuals to access TWDB funds through participating local and state depository banks and farm credit institutions.

- TWDB <http://www.twdb.texas.gov/financial/programs/AWCL/index.asp>

USDA Farm Service Agency

Conservation Reserve Program

The Conservation Reserve Program is a land conservation program managed by the Farm Service Agency where in exchange for a yearly rental payment, farmers agree to remove

environmentally sensitive land from agricultural production. Eligibility is limited to cropland or certain marginal pastureland suitable for riparian buffer of similar water quality purposes.

- USDA Farm Service Agency
<http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=crp> and
<https://www.fsa.usda.gov/programs-and-services/conservation-programs/prospective-participants/index>

USDA-NRCS

Financial Assistance through USDA-NRCS

The NRCS offers a variety of financial assistance programs to landowners and agricultural producers through the 2014 Farm Bill. General information on USDA-NRCS financial assistance programs can be found at the link below. More details are provided for programs that would be eligible to producers in the Nolan Creek/South Nolan Creek watershed.

- USDA-NRCS
<https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/>

Environmental Quality Incentives Program

The Environmental Quality Incentives Program (EQIP) is a voluntary conservation program that offers financial and technical assistance to agricultural producers in addressing specific land use issues. Contracts through EQIP provide financial assistance to implement conservation practices. Funding through EQIP may be used to help implement practices defined in a WQMP or conservation plan.

- USDA-NRCS
<https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/>

Conservation Innovation Grants

Conservation Innovation Grants (CIG) are competitive grants to develop the tools, technologies, and strategies for public and private sector innovation in resource conservation. Producers involved with CIG must be EQIP eligible and grantee must leverage federal funding with at least matching funds.

- USDA-NRCS
<https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/cig/>

Conservation Stewardship Program

The Conservation Stewardship Program (CSP) offers payments to maintain existing conservation practices. Priorities for funding are based on the operation type and number of resource concerns that are meeting the stewardship level at the time of application and payments needed to implement additional or enhanced conservation activities.

- USDA-NRCS
<https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/programs/financial/csp/?cid=nrseprd1288524>

Watershed and Flood Prevention Operations Program

The NRCS can assist through the Watershed and Flood Prevention Operations (WFPO) Program with funding the operations of projects to aid with watershed and flood prevention. Prior to requesting funding, the sponsor must work with NRCS to develop an approved watershed plan. Funding and priorities through this program can vary, so NRCS should be contacted regarding plan development and funding options.

- USDA- NRCS
<https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/wfpo/>

USDA-Rural Development

Single Family Housing Repair Loans and Grants

Also known as the Section 504 Home Repair program, this program provides loans to very low incomes homeowners for repairs or improvements to remove health and safety hazard. Grants are available to low-income elderly over 62 and unable to repay a repair loan. These home repair grants and loans may be a potential funding source for OSSFs.

- USDA-Rural Development <https://www.rd.usda.gov/programs-services/single-family-housing-repair-loans-grants>
 - Texas Housing Program Contact (243) 742-9770 or
RA.TXTempleHSG.RDmailbox@tx.usda.gov

US Department of Health & Human Services

Targeted Homeless Assistance Programs

The US Department of Health & Human Services (HHS) provides a variety of assistance programs designed specifically for assisting individuals or families experiencing homelessness. These include assistance with housing, health care, job training, and other supportive needs that might be considered in addressing the homelessness problem within the watershed area.

Supportive Services: Non-targeted or Mainstream Programs

Supportive services under HHS focus more on community grants to assist low income individuals including the homeless and include programs such as Community Mental Health Service Block Grants, Family Violence Prevention and Services Grant Program, and Temporary Assistance for Needy Families.

- US Department of HHS – <https://www.hhs.gov/programs/social-services/homelessness/grants/index.html#mainstream>

Table 4-1 Summary of potential funding sources from state and federal agencies.

Agency	Program	Management Strategy														
		WWTF	Sewer Lines	OSSFs	Home-less	Pet Waste	Illegal Dumping	Urban Storm-water	Rural Storm-water	Roosting Birds	Wild-life	Recreational Use	Flood Mgt	MST	Stream Monitoring	Watershed Coordinator
EPA	CWA 319			x		x	x	x	x	x	x			x	x	x
EPA	EE Grants		x	x		x	x	x	x		x					x
TCEQ	SEPs	x	x	x				x								
TCEQ	CRP														x	
TDA	CDBG	x	x					x								
TDA	Texas Capital Fund	x	x					x								
TPWD	F&RLCP								x		x		x			
TPWD	LIP								x		x		x			
TPWD	RTF											x				
TPWD	Local Parks											x				
TSSWCB	WQMPs								x				x			
TSSWCB	Flood Control												x			
TSSWCB	WSEP								x				x			
TWDB	CWSRF	x	x					x								
TWDB	EDAP	x	x	x												
TWDB	AWCL								x							
USDA-FSA	Conservation Reserve Program								x				x			
USDA-NRCS	EQIP								x				x			
USDA-NRCS	CIG								x							

Watershed Action Plan for the Nolan Creek/South Nolan Creek Watershed

Agency	Program	Management Strategy														
		WWTF	Sewer Lines	OSSFs	Homeless	Pet Waste	Illegal Dumping	Urban Stormwater	Rural Stormwater	Roosting Birds	Wildlife	Recreational Use	Flood Mgt	MST	Stream Monitoring	Watershed Coordinator
USDA-NRCS	CSP								x				x			
USDA-NRCS	WFPO								x				x			
USDA-Rural Development	Sect 504		x	x												
US HSS	Targeted Homeless & Supportive Services				x											

SECTION 5

Proposed Schedule for Management Measures

Implementation of management measures within the Nolan Creek/South Nolan Creek watershed will occur incrementally with higher priority item (human waste sources and pet waste) as the primary focus initially (Table 5-1). The highest priority will be hiring a Watershed Coordinator to help make all these activities happen. An adaptive management approach is recommended with an evaluation at the end of years three, six, and ten to assess if priorities should be changed, particularly if new information arises through monitoring or MST efforts, and as specific management measures are defined for dealing with bacteria contributions from the homeless.

Table 5-1 Outline for implementation of management activities.

Area	Responsible Party	Activity or Management Measure	Timeframe	Priority for Implementation	Estimated Cost	Anticipated Reductions ¹
Overall WPP	Nolan Creek Partnership	Develop funding and hire a watershed coordinator	Year 1	High	About \$70,000 per year	High, responsible for coordinating all WAP activities
WWTFs	Watershed Coordinator and WWTFs	Track reported bacteria concentrations associated with WWTF discharges and compare with instream water quality	Once every six months report on website. Annual report to WPP in public meeting.	High	Covered under Watershed Coordinator	Low, as keeping bacteria concentrations below limits already required by permit and generally occurs
Sewer Line Infrastructure - Private	Private Landowners in cooperation with Municipalities and Watershed Coordinator	Educate private property owners on responsibilities regarding lateral lines	Focus in years 1-3	High	To be determined (cost dependent on approach)	Moderate
	Private Landowners in cooperation with Municipalities and Watershed Coordinator	Educate owners and renters on how to maintain clear lateral lines	Focus in years 1-3	High		Moderate
	Private Landowners in cooperation with Municipalities and	Educate owners and renters on how to identify leakage or blockage problems with lateral lines for	Focus in years 1-3	High		Moderate

Watershed Action Plan for the Nolan Creek/South Nolan Creek Watershed

Area	Responsible Party	Activity or Management Measure	Timeframe	Priority for Implementation	Estimated Cost	Anticipated Reductions ¹
	Watershed Coordinator	wastewater located on private property and what to do when problems occur				
	Private Landowners in cooperation with Municipalities and Watershed Coordinator	Develop and implement a voluntary inspection program of lateral lines on private property focusing on high density housing/population areas	Focus in years 4-6	Medium	Personnel to develop & implement program	Moderate
	Private Landowners in cooperation with Municipalities and Watershed Coordinator	Develop a financial assistance program for maintenance, repairs and/or replacement of lateral lines	Focus in years 1-6	High	Estimated \$100 to \$3,000 for repairs and/or replacement of lateral lines per connection	Moderate
OSSFs	Watershed Coordinator in conjunction with municipalities and BCHD	Locate OSSFs, particularly those close to the creek	Ongoing	Moderate	Personnel time	Moderate
	Municipalities	Maintain and update an inventory of OSSFs within CCNs that are still in use and those that have been connected to the centralized	Ongoing	High	Personnel time to coordinate, some already being done by municipalities	Moderate

Watershed Action Plan for the Nolan Creek/South Nolan Creek Watershed

Area	Responsible Party	Activity or Management Measure	Timeframe	Priority for Implementation	Estimated Cost	Anticipated Reductions ¹
		wastewater collection system and share OSSF maps/databases with Watershed Coordinator and other entities in the watershed				
	Nolan Creek Partnership working with Bell County	Provide a mechanism to encourage installation of smaller centralized OSSFs in new subdivisions rather than installing individual OSSFs with each house	Focus in years 4-6	Medium	Unknown	Low
	Municipalities and BCHD	Target connecting OSSFs within municipal boundaries to the centralized sewer system	Ongoing	High	Personnel time	Moderate
	Private landowners, Municipalities and Watershed Coordinator	Aid in identifying and providing financial assistance for connection of households to the centralized sewer system and removal of decommissioned OSSFs	Focus in years 1-3	High	Estimated OSSF replacement \$5,000 to \$10,000, repairs \$1,000 to \$5,000, and decommission about \$2,000	Moderate

Watershed Action Plan for the Nolan Creek/South Nolan Creek Watershed

Area	Responsible Party	Activity or Management Measure	Timeframe	Priority for Implementation	Estimated Cost	Anticipated Reductions ¹
	Nolan Creek Partnership	Make recommendations to the State of Texas via TCEQ to increase the inspection requirements for OSSFs and the companies licensed to inspect OSSFs.	Focus in years 4-6	Medium	Personnel time	Low
	Nolan Creek Partnership	Make recommendations to the State of Texas via TCEQ to increase the minimum lot size required from half an acre to at least one acre for individual OSSFs.	Focus in years 4-6	Medium	Personnel time	Low
	Nolan Creek Partnership working with Bell County	Through the county, promote installation of small, centralized OSSFs in new rural subdivisions rather than individual OSSFs.	Focus in years 4-6	Medium	Unknown	Low
	Nolan Creek Partnership & Bell County	Develop and provide financial assistance program for those with OSSF compliance issues to aid in repairing or replacing failing systems.	Focus in years 1-6	High	Estimated OSSF replacement \$5,000 to \$10,000, repairs \$1,000 to \$5,000	Moderate

Watershed Action Plan for the Nolan Creek/South Nolan Creek Watershed

Area	Responsible Party	Activity or Management Measure	Timeframe	Priority for Implementation	Estimated Cost	Anticipated Reductions ¹
	Bell County & Watershed Coordinator	Educate users of OSSFs on maintenance	Focus in years 1-3	High	Mailings about \$2,000 each	Moderate
	Nolan Creek Partnership in conjunction with Texas A&M AgriLife Extension	Sponsor OSSF workshops/trainings for homeowners	One per year for first 10 years	High	About \$3,500 per workshop	Moderate
	Nolan Creek Partnership in conjunction with Texas A&M AgriLife Extension	Sponsor OSSF workshops/trainings for installers and maintenance providers	About one every three years	High	About \$3,500 per workshop	Moderate
Homeless	Nolan Creek Partnership with Municipalities & Other Entities	Work with municipalities and other organizations in defining management measures that address the bacteria contributions from homeless population	First three years	High	Limited to planning but costs will increase as specific measures are defined for implementation	Moderate
Pet Waste	Nolan Creek Partnership with Municipalities	Support and expand public outreach and educational programs encouraging proper disposal of pet waste	Focus in years 1-3	High	Covered under other activities using newsletters, website information, and other "traditional" education avenues	High
	Nolan Creek Partnership	For the entire watershed area,	Focus in years 1-3	High	Additional \$5,000 per year	Moderate

Watershed Action Plan for the Nolan Creek/South Nolan Creek Watershed

Area	Responsible Party	Activity or Management Measure	Timeframe	Priority for Implementation	Estimated Cost	Anticipated Reductions ¹
	with Municipalities	develop a pet waste pick-up campaign			for educational campaign & time from Watershed Coordinator	
	Nolan Creek Partnership with Municipalities	Support the use and provide additional pet waste stations in public areas within the watershed	Focus in years 1-3	High	About \$650/station & \$300/yr maintenance per station	Moderate
Illegal Dumping	Nolan Creek Partnership, TCEQ & TxDOT	Implement signage at major highway crossing on how to report illegal dumping	Focus in years 4-6	Medium	Unknown	Low
	Nolan Creek Partnership with Municipalities	Support and aid creek cleanup events planned by other entities and sponsor at least one separate creek cleanup event per year	Focus in years 1 -10	High	About \$2,000 per event (supplies)	Moderate
	Nolan Creek Partnership	Promote available options for HHW disposal and planned HHW events through newsletters, website, and other outreach venues	Ongoing	Medium	Part of duties associated with Watershed Coordinator, informational material combined with other activities	Low
	Nolan Creek Partnership	Use HHW and creek cleanup events as an opportunity for educational	Ongoing	Medium	Time of Watershed Coordinator to participate in events	Low

Watershed Action Plan for the Nolan Creek/South Nolan Creek Watershed

Area	Responsible Party	Activity or Management Measure	Timeframe	Priority for Implementation	Estimated Cost	Anticipated Reductions ¹
		outreach to reduce illegal dumping				
	Nolan Creek Partnership	Promote educational information on proper trash and dead animal disposal through newsletters, website, and other outreach venues	Ongoing	Medium	Part of duties associated with Watershed Coordinator, informational material combined with other activities	Low
Increasing Infiltration and Reducing Runoff	Nolan Creek Partnership	Support practices outlined SWMPs, particularly those associated with post-construction stormwater management in new development and redevelopment areas that increase infiltration and reduce runoff, through coordinated educational efforts	Ongoing	Medium	Limited to time from watershed coordinator	Moderate to Low
	Nolan Creek Partnership in conjunction with municipalities, Texas A&M AgriLife Extension & TCEQ	Specifically promote LID practices through educational workshops	At least one workshop every three years and development of demonstrations site(s) as funding allows	Medium	To be determined	Moderate to Low

Watershed Action Plan for the Nolan Creek/South Nolan Creek Watershed

Area	Responsible Party	Activity or Management Measure	Timeframe	Priority for Implementation	Estimated Cost	Anticipated Reductions ¹
	Nolan Creek Partnership in conjunction with municipalities and Bell County	Support funding efforts for the implementation and demonstration of LID practices by municipalities and other entities	Ongoing	Medium	Limited to time from watershed coordinator	Moderate to Low
	Bell County	Promote Residential Cluster Development for new developments	Ongoing	Medium	Unknown	Low
Livestock Waste	Nolan Creek Partnership in conjunction with Texas A&M AgriLife Extension, TSSWCB, & NRCS	Educate livestock producers on good management practices for maintaining healthy streams via workshops and distribution of educational resources.	Conduct one workshop every three years with at least 15 attendees/workshop	Medium	Costs generally underwritten	Moderate
	Nolan Creek Partnership in conjunction with Texas A&M AgriLife Extension, TSSWCB, & NRCS	Develop awareness of the planning process for WQMPs, conservation plans, and other planning options	Done through workshops and other educational materials	Medium	Covered under other activities	Moderate
	Nolan Creek Partnership in conjunction with Texas A&M AgriLife Extension, TSSWCB, & NRCS	Promote development of WQMPs, conservation plans, or other conservation plans by livestock owners in the watershed	On-going	Medium	Plan development generally free, but about \$15,000 per plan needed for implementation	Moderate

Watershed Action Plan for the Nolan Creek/South Nolan Creek Watershed

Area	Responsible Party	Activity or Management Measure	Timeframe	Priority for Implementation	Estimated Cost	Anticipated Reductions ¹
		(goal 5 WQMPs per year)				
Horse Waste	Nolan Creek Partnership in conjunction with Texas A&M AgriLife Extension, TSSWCB, & NRCS	Educate horse owners on good management practices for maintaining healthy streams via workshops and distribution of educational resources.	Conduct one workshop every three years with at least 15 attendees/workshop	Medium	Costs generally underwritten	Moderate
	Nolan Creek Partnership in conjunction with Texas A&M AgriLife Extension, TSSWCB, & NRCS	Develop awareness of the planning process for WQMPs and conservation plans	Done through workshops and other educational materials	Medium	Covered under other activities	Moderate
	Nolan Creek Partnership in conjunction with Texas A&M AgriLife Extension, TSSWCB, & NRCS	Promote develop of WQMPs and/or conservation plans by horse owners in the watershed (Goal 2 WQMPs per year)	On-going	Medium	Plan development generally free, but about \$15,000 per plan needed for implementation	Moderate
Feral Hogs	Nolan Creek Partnership in conjunction with Texas	Educate landowners on management measures to aid in hog reduction	Make available already existing educational materials through website and other electronic media	Low	Limited to time from watershed coordinator	Low

Watershed Action Plan for the Nolan Creek/South Nolan Creek Watershed

Area	Responsible Party	Activity or Management Measure	Timeframe	Priority for Implementation	Estimated Cost	Anticipated Reductions ¹
	Wildlife Services		and advertise workshops in adjoining watersheds			
	Nolan Creek Partnership in conjunction with Texas Wildlife Services	Host feral hog workshops in the watershed	One every three years	Low	Variable	Low
	Nolan Creek Partnership	Promote management options, such as Hogs for a Cause, to help with trapping of hogs	On-going	Low	Limited to time from watershed coordinator	Low
Roosting Birds	Nolan Creek Partnership in conjunction with Texas Wildlife Services	Make landowners aware of assistance available from Texas Wildlife Services on methods for decreasing attractiveness of areas to roosting	Focus in years 7-10	Low	Limited to time from watershed coordinator	Low
	Private Landowners in cooperation with Municipalities and Watershed Coordinator	If a discouragement or frighten plan is developed, assist with education of the public regarding proposed tactics	Focus in years 7-10	Low	Limited to time from watershed coordinator	Low (although may to moderate to high at specific location)
Wildlife	Nolan Creek Partnership in conjunction TPWD	Provide educational materials to the public to discourage feeding of waterfowl and	On-going	Medium	Limited to time from watershed coordinator	Low (although may to moderate at specific location)

Watershed Action Plan for the Nolan Creek/South Nolan Creek Watershed

Area	Responsible Party	Activity or Management Measure	Timeframe	Priority for Implementation	Estimated Cost	Anticipated Reductions ¹
		small mammals via website				
	Municipalities	Add signage "Do Not Feed Waterfowl" in known feeding locations	First three years	Medium	Costs about \$250/sign	Low (although may to moderate at specific location)
	Nolan Creek Partnership in conjunction TPWD	Monitor population densities to assess if further management is needed	On-going	Low	Limited to time from watershed coordinator	Low
	Nolan Creek Partnership in conjunction TPWD	If population densities are considered large enough to warrant control, consult with TPWD on options for control	Focus in years 7-10	Low	Limited to time from watershed coordinator	Low
	Nolan Creek Partnership in conjunction TPWD	If deemed necessary, implement population control measures	Focus in years 7-10	Low	To be determined	Unknown, depends on density
	Nolan Creek Partnership in conjunction with TSSWCB, NRCS, TFS, and TPWD	Promote landowner use of conservation planning for wildlife through TSSWCB, NRCS, TFS, and TPWD.	On-going	Low	Limited to time from watershed coordinator to promote	Low

Watershed Action Plan for the Nolan Creek/South Nolan Creek Watershed

Area	Responsible Party	Activity or Management Measure	Timeframe	Priority for Implementation	Estimated Cost	Anticipated Reductions ¹
Recreational Activities	Nolan Creek Partnership with Municipalities & CTCOG	Promote safe usage of Nolan Creek/South Nolan Creek through educational information provided via website and other venues	Years 1-10	High	Limited to time from watershed coordinator to promote	Low
	Nolan Creek Partnership with Municipalities & CTCOG	Coordinate WAP activities with creek recreational activities promoted by municipalities often associated with city parks as well as through planning and maintenance of bicycle and pedestrian trails	Ongoing	High	Limited to time from watershed coordinator	Low to Moderate
	Municipalities with Nolan Creek Partnership	Install more trash and pet waste stations in areas near the creek associated with increased recreational use (goal 3 added station per year)	Years 1 - 10	Medium	Stations about \$650 each, maintenance about \$100/station per yr, signage about \$250/sign	Moderate
	Nolan Creek Partnership with Municipalities & CTCOG	Support implementation of educational signage within parks and along trails (goal three	Years 1-3	Medium	Signage about \$250/sign	Moderate

Watershed Action Plan for the Nolan Creek/South Nolan Creek Watershed

Area	Responsible Party	Activity or Management Measure	Timeframe	Priority for Implementation	Estimated Cost	Anticipated Reductions ¹
		signs in first three years)				
	Nolan Creek Partnership with Municipalities & CTCOG	Support of the development of riparian buffers as part of trail systems associated with the creek corridor	Ongoing	Medium	Limited to time from watershed coordinator	Low to Moderate
Flood Management	Municipalities, Bell County & CTCOG	Support ongoing flood planning and as part of adaptive management, particularly recommendations for development of bioswales, detention or bio-retention ponds for flood management	Ongoing	Medium	Limited to time from watershed coordinator	Low to Moderate
	WCID No. 6, Municipalities, & Central Texas SWCD	Support ongoing assessment and rehabilitation efforts associated with small lakes and flood control reservoirs within the watershed	Ongoing	Medium	Limited to time from watershed coordinator	Low to Moderate
Microbial Source Tracking	Nolan Creek Partnership with Municipalities	Develop funding for MST	Focus in years 1-3	High	Limited to time from watershed coordinator interacting with municipalities	Low
	Nolan Creek Partnership with Municipalities	Design & implement MST study	Focus in years 4-6	Medium	About \$250,000	Low

Watershed Action Plan for the Nolan Creek/South Nolan Creek Watershed

Area	Responsible Party	Activity or Management Measure	Timeframe	Priority for Implementation	Estimated Cost	Anticipated Reductions ¹
	Nolan Creek Partnership with Municipalities	Analyze MST results and evaluate management measures in light of MST findings	Focus in years 7-10	Medium	Limited to time from watershed coordinator interacting with the Nolan Creek Partnership	Moderate to High
Nutrient Reduction Efforts	Nolan Creek Partnership with Municipalities	Provide educational to homeowners, golf courses, and landscape operations on fertilizer application	On-going through website and other electronic media	Low	Limited with linkage to existing materials and programs	Low
	Nolan Creek Partnership with Municipalities	Encourage use of fertilizer containing only nitrogen and no phosphorus for lawn care	On-going through website and other electronic media	Low	Limited with linkage to existing materials and programs	Low
	Nolan Creek Partnership in conjunction with AgriLife Extension, TSSWCB, & NRCS	Encourage development of nutrient management plans for use of fertilizers on agricultural lands	On-going in relation to WQMPs, conservation plans and other land planning efforts	Low	Costs related to implementation under other land management activities	Low

1. Anticipated reductions related to bacteria except for nutrient reduction efforts.

References

EPA, Environmental Protection Agency. 2008. Handbook for Developing Watershed Plans to Restore and Protect Our Waters. EPA Office of Water, Nonpoint Source Control Branch, Washington, D.C. EPA 841-B-08-002 (March 2008) Available at: <http://www.epa.gov/polluted-runoff-nonpoint-source-pollution/handbook-developing-watershed-plans-restore-and-protect> (Link verified November 10, 2017).

Featherston, J.W. 2009. Search for the Elusive 35%: A Sponsor Dilemma. Talk presented at the 11th National Watershed Conference, May 17-20, 2009 in Wichita, Kansas, by James W. Featherston, Agricultural Economist, USDA-NRCS, Temple, Texas. Available at: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/?&cid=nrcs143_009714 (Link verified November 17, 2017).

Huckabee, J.W. Jr., D.R. Thompson, J.C. Wyrick, and E.G. Pavlat. 1977. Soil Survey of Bell County. United States Department of Agriculture, Soil Conservation Service in cooperation with the Texas Agricultural Experiment Station. USDA-SCS, Washington, D.C.

McFarland, A., and T. Adams. 2015a. Characterizing Water Quality within Nolan Creek/South Nolan Creek. Prepared for the Texas Commission on Environmental Quality by the Texas Institute for Applied Environmental Research and the City of Killeen, TR1508.

McFarland, A., and T. Adams. 2015b. Survey of Potential Bacteria and Nutrient Sources in the Nolan Creek/South Nolan Creek Watershed. Prepared for the Texas Commission on Environmental Quality by the Texas Institute for Applied Environmental Research and the City of Killeen, TR1410.

McFarland, A., and T. Adams. 2015c. Characterizing Potential Pollutant Loads to Nolan Creek/South Nolan Creek. Prepared for the Texas Commission on Environmental Quality by the Texas Institute for Applied Environmental Research and the City of Killeen, TR1507.

Nett, J.P., and J.D. Flowers. 2008. Assessment and Targeting of Bacterial Sources in the South Nolan Creek Watershed. Prepared for the Texas Commission on Environmental Quality by the City of Killeen and Jacobs Carter Burgess, Inc.

Parsons Water & Infrastructure Inc. and the Brazos River Authority. 2015. Watershed Protection Plan for the Leon River Below Proctor Lake and Above Belton Lake. Prepared for the Stakeholders of the Leon River Watershed by Parson, the Texas State Soil & Water Conservation Board, the Brazos River Authority, and US Environmental Protection Agency through a Clean Water Act Section 319(h) grant. Available at: <http://leonriver.tamu.edu/media/1110/final-leon-wpp.pdf> (Link verified November 21, 2017).

Prcin, L., R. Srinivasan, and P. Casebolt. 2013. The Lampasas River Watershed Protection Plan. Prepared for the Lampasas River Watershed Partnership by Texas A&M AgriLife, the Texas State Soil & Water Conservation Board, and US Environmental Protection Agency through a Clean Water Act Section 319(h) grant. Available at:

http://www.lampasasriver.org/media/72931/lampasas-river-wpp_june-2013.pdf (Link verified November 21, 2017).

TCEQ, Texas Commission on Environmental Quality. 2015a. 2014 Texas Integrated Report - Texas 303(d) List (Category 5). Online at: https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/14txir/2014_303d.pdf (link verified November 10, 2017).

TCEQ, Texas Commission on Environmental Quality. 2015b. 2014 Texas Integrated Report, Water Bodies with Concerns for Use Attainment and Screening Levels (November 19, 2015). Online at: https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/14txir/2014_concerns.pdf (link verified November 10, 2017).

TCEQ, Texas Commission on Environmental Quality. 2015c. 2014 Texas Integrated Report - Potential Sources of Impairments and Concerns (November 19, 2015). Online at: https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/14txir/2014_303d.pdf (link verified November 10, 2017).

TCEQ, Texas Commission on Environmental Quality. 2015d. 2014 Guidance for Assessing and Reporting Surface Water Quality in Texas. TCEQ, Austin, TX (June 2015). Online at: https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/14txir/2014_guidance.pdf (link verified November 10, 2017).

TCEQ, Texas Commission on Environmental Quality. 2011a. 2010 Texas Water Quality Inventory Water Bodies Evaluated. Online at: https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/10twqi/2010_summary.pdf (link verified January 5, 2018).

TCEQ, Texas Commission on Environmental Quality. 2011b. 2010 Texas Integrated Report - Texas 303(d) List (Category 5). Online at: https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/10twqi/2010_303d.pdf (link verified January 5, 2018).

TCEQ, Texas Commission on Environmental Quality. 1997. State of Texas 1996 303(d) List. TCEQ, Austin, TX (04/09/97). Online at: https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/96_303d.pdf (link verified January 5, 2018).

USGS, United States Geological Survey. 2014. Multi-Resolution Land Characteristics (MRLC) Consortium National Land Cover Database 2011. Online at: <http://www.mrlc.gov/nlcd2011.php> (link verified November 12, 2015).

Wolfe, J. 2014. Nolan Creek Flow: Potential Changes Related to Upstream Influence. Report prepared for the City of Belton but the Texas A&M AgriLife Research, Blackland Research and Extension Center, Water Science Laboratory. Online at: https://blackland.tamu.edu/files/2017/10/Nolan_Creek_Low_Flow_Assessment_BREC_Final.pdf (link verified December 6, 2017).

Appendix A

Public Sewer Line Infrastructure

Management of the public infrastructure of the sewer line infrastructure includes items, such as maintenance of the collection system, illicit discharge and elimination programs, procedures for dealing with discharges and spill, as well as program to minimize sewer overflows and blockages. These items related to the public infrastructure of the sewer system are largely addressed via SWMPs associated with each community. A summary of ongoing or planned activities related to the public infrastructure of the sewer system is presented below from SWMPs and other sources.

Collection System Maintenance

Inspection activities to detect leaks and identify rehabilitation needs for sewer lines are ongoing for municipalities within the Nolan Creek/South Nolan Creek watershed. Leak detection is largely coordinated within SWMPs of each community in dealing with illicit discharge detection and elimination (IDDE).

For example in July 2017, the Killeen City Council approved an updated evaluation of its Water and Wastewater Master Plan, which was last drafted in 2012. This analysis of Killeen's infrastructure will update and layout needed capital improvements and repairs. Work is ongoing to rehabilitate and replace wastewater mainlines within Killeen. As part of Killeen's SWMP, a goal is to clean 35,000 ft/yr and television video (TV) inspect 12,000 ft/yr of sewer lines to aid in eliminating sanitary system overflows (SSOs).

Illicit Discharge Detection and Elimination Programs

Illicit Discharge Detection and Elimination programs focus on the detective work needed to hunt down and correct illicit connections. This involves understanding the sewage collection system, but also the stormwater drainage as it leads to the creek. As part of the MS4 general permit, each entity is required to submit a SWMP that specifically addresses IDDE. Requirements in part include mapping storm drainage outfalls in relation to surface waters; developing an IDDE program for detecting, investigating, and eliminating illicit discharges; and educating and training municipal staff.

Stormwater ordinances for illicit discharges already exist for the cities of Belton, Harker Heights, and Killeen. The City of Nolanville within its SWMP has set a target date of 2019 for adopting a city ordinance for illicit discharges.

Procedures for Tracking, Responding and Removing Illicit Discharges and Spills

As part of their SWMPs, specific procedures for tracking, responding, and removing illicit discharges and spills have been developed by each municipality. These includes things such as dry weather screening and response training of personnel.

In addressing illicit discharges, each MS4 entity has public reporting and response procedures for complaints noted as follows:

- **Killeen** (SWMP) – Drainage Utility Response line (254) 501-7629, 24-hr hotline for reporting stormwater drainage issues. The Water and Sewer Department in Killeen deals with wastewater lines. The City of Killeen has a specific number for reporting leaks, sewer blockages, and overflows as (254) 501-6500 [alternate number (254) 501-6310] noted on their webpage at (<http://www.killeentexas.gov/index.php?section=125>).
- **Fort Hood** (SWMP) – Through the Fort Hood municipal stormwater program, illicit discharges may be reported via email through its website by clicking on the “Please Don’t Feed the Storm Drain” logo at <http://www.hood.army.mil/dpw/Environmental/Municipal%20storm%20water.aspx>.
- **Harker Heights** (SWMP) – The City of Harker Heights Public Works Department has regular hours and after hours duty phone numbers as well as stormwater hotline noted on its website (<http://www.ci.harker-heights.tx.us/index.php/public-works>). These numbers are provided below.
 - Regular hours (254) 953-5649
 - After Hours Emergency Numbers
 - Water Leaks (254) 681-6779
 - Sewer Stops (254) 702-4893
 - Street, Drainage & Sanitation (254) 319-4996
 - Stormwater Hotline
 - Regular Hours (254) 953-5649
 - Holidays, weekends & after 5 pm weekdays (254) 319-4996
- **Nolanville** (SWMP) – The City of Nolanville provides an illegal dumping notification link on City of Nolanville’s website for all “concerns” at http://ci.nolanville.tx.us/page/Report_Concerns.
- **Belton** (SWMP) – Within the City of Belton, the Public Works Department can be contacted at (254) 933-5823 regarding illegal dumping or discharges.
- **Bell County** (SWMP) – For illegal dumping, the Bell County Engineer’s Office should be contacted at (254) 933-5275.

Programs to Minimize Sewer System Overflows from Blockage

Municipalities are also actively working to minimize SSOs. Most past SSOs in the watershed have been related to FOG issues, but things, such as baby wipes, facial wipes, sanitary pads, and tampons, can create blockages, particularly when large amounts are flushed down the drain. The larger municipalities in the watershed all have FOG ordinances focused on businesses that use a lot of oils and grease, such as food service and auto related operations. These FOG ordinances include inspections for compliance and enforcement of remediation, if businesses are found out of compliance.

An example is the Harker Heights ordinance dealing with Fats, Oils, and Greases (§53.28) for non-residential uses of the wastewater system and transporters of grease or grit trap waste

(http://www.ci.harker-heights.tx.us/docs/22-53_28FatsOilsAndGreases_ControlAndPrevention.pdf).

Information on Killeen's FOG program, including educational brochures, can be found at on the city's website at <http://www.killeentexas.gov/index.php?section=126>.

Fort Hood also includes a FOG training course offered to Dining Facilities Administration Centers (DFACs) and commercial restaurants to help reduce the amount of grease buildup in sewer lines (http://www.hood.army.mil/dpw/Environmental/MCM_1.aspx).

The cities of Killeen and Harker Heights have agreements to participate in TCEQ's Sanitary Sewer Overflow Initiative (<https://www.tceq.texas.gov/compliance/investigation/ssoinitiative>).

Appendix B

Urban SWMP Activities

Within the SWMPs associated with the Nolan Creek/South Nolan Creek watershed, a variety of activities are already addressed that should aid in control of bacterial runoff to the creek. A summary of these activities is provided below as an indication of ongoing efforts in the watershed.

Pollution Prevention and Good Housekeeping for Municipal Operations

Because preventing pollutants from entering waterways is less expensive than trying to restore a waterway once polluted, good housekeeping for municipalities focuses on developing and implementing an operations and maintenance program for city-owned facilities and operations. This program includes items such as vehicle maintenance practices, chemical use and storage, and roadway cleaning/sweeping. For pollution prevention, inspection and maintenance of the stormwater drainage system is included under good housekeeping for municipal operations, which ties in directly with IDDE programs and efforts to minimize illegal dumping.

Construction Practices

Runoff from construction sites, if not controlled, can potentially carry large amounts of sediment. As part of their MS4 permits, entities are required to develop a program to reduce sediment from construction sites focusing on areas one acre or greater. This involves the development and passage of ordinances, a program requiring construction site operators to implement erosion control best management practices, requirements to control other waste at the construction site, review of construction site plans with consideration to impacts on water quality, and inspections and enforcement of construction control measures. There also needs to be a process for receiving and considering information submitted by the public regarding construction activities. Construction practices are addressed more fully in SWMPs of each entity in the watershed. The practices outlined in these SWMPs are important as sedimentation not only can cause water quality problems by blocking sunlight and filling creeks and other water bodies, it can carry with it other pollutants, including bacteria from the land surface.

Post-Construction Practices

Practices to increase infiltration and reduce runoff are a focus of post-construction stormwater management in new development and redevelopment areas as part of SWMPs. Some other activities noted in SWMPs or other planning documents for entities in the watershed include the following:

- The Comprehensive Plan for the City of Killeen finalized in 2010 recommends expansion and connection of parks and green spaces across the region and recognizes the importance of preserving existing green and open space, particularly in floodplain areas (<http://www.killeentexas.gov/index.php?section=178>). Building nature into Killeen is

weaved throughout the Comprehensive Plan with themes of open space preservation and “green” development including creek corridors and their floodplains. For the City of Killeen, this includes a maintenance plan that involves putting riparian areas, where feasible, back into native vegetation. Near schools “safe ways” must be included that involve clearing and mowing to “lawn standards” to allow visibility. The City of Killeen Drainage Master Plan developed in 2012 recommends “conventional” BMPs such as sedimentation/filtration ponds, wet ponds and vegetative filter strips and use of low impact development (LID) and construction techniques (<http://www.killeentexas.gov/index.php?section=281>).

- The Fort Hood SWMP notes its requirement to comply with Section 438 of the Energy Independence and Security Act of 2007, which has goals similar to the MS4 general permit, to which Fort Hood plans to develop and implement a LID program. (http://www.hood.army.mil/dpw/Environmental/MCM_5.aspx).
- For Harker Heights, the SWMP includes developing and disseminating information on topics such as landscape design, xeriscaping, reusing yard wastes, and composting as way to increase infiltration and reduce stormwater runoff. Some educational brochures on these topics are available on the Harker Heights stormwater website (<http://www.ci.harker-heights.tx.us/index.php/storm-water>).
- The Nolanville SWMP encourages and promotes low impact/green designs in partnership with the Central Texas Home Builders Association (target date 2016-2020) and includes identifying and promoting buffer areas around natural waterways (target date 2018).
- Belton within its SWMP plans to identify buffer areas to promote vegetation and install signs that define these management area and also identify future buffer areas as the city continues to develop.
- Bell County (SWMP) promotes use of unlined or pervious drainage ditches instead of impervious concrete gutters or underground storm drain systems. These above ground open, grassy drainage ditch systems allow more stormwater runoff to soak into the ground, reducing runoff and some of the pollutants that might otherwise reach our waterways.

Industrial Practices

For MS4 areas supporting a population of 100,000 or more, industrial practices for pollution control must also be addressed within SWMPs. Within the Nolan Creek/South Nolan Creek, the City of Killeen is the only MS4 entity that meets this population threshold. Industrial activities can vary greatly but focus on material handling and storage, equipment maintenance and cleaning, and other activities that may lead to the transport of industrial pollutants via the storm drainage system (<https://www.epa.gov/npdes/stormwater-discharges-industrial-activities>). Within the City of Killeen, ordinances for the municipal drainage utility system include industrial wastes and potential runoff. Within Killeen’s SWMP, additional activities focus on identifying priorities, adopting a procedures program for industrial stormwater, and developing and implementing an industrial stormwater testing program.

Appendix C

Proposed Bioswale Implementation within Nolanville

Within the City of Nolanville, there are several tributaries that lead to South Nolan Creek. The City of Nolanville proposes designing bioswales on four of these tributaries. The function of the bioswales in these locations is threefold: to reduce levels of bacteria and pollutants leading to South Nolan Creek; to prevent future flooding in the surrounding areas; and to educate the residents on ways to reduce future bacteria deposition into Nolanville's waterbodies. The project would not only implement the four bioswales, but also estimate pollutant loadings and reductions associated with these bioswales and include an educational component on LID and water quality impacts. The four areas recommended for implementation of bioswales are as follows:

Area 1:

The first location, located at 10th Street and E. Avenue H., is adjacent to the Community Center. The stream is often stagnant, with algal blooms and eutrophication occurring, causing aquatic ecosystems to suffer and creating an unpleasant aroma. The inclusion of a bioswale at this location, accompanied by street trees and educational signage, would help to filter runoff and slow water movement into South Nolan Creek. This area serves as the central point for the collection of water for the eastern portion of Nolanville. Due to this it often floods the streets and has caused flood damage to surrounding residences. A bioswale designed to infiltrate quicker and hold more water would decrease future flood damage in this area. The educational signage would explain the importance of a healthy waterbody as well as demonstrate the function of bioswales. Due to its proximity to the Community Center and a series of parks and play spaces this area has a high population density which leads the space to serve as a highly utilized asset that educates and engages the users on the importance of preventing future water pollution.

Area 2:

The second location (Area 2), located at West Avenue and 7th Street, is adjacent to Nolanville's City Hall. This site often lays stagnant during dry seasons and severely floods during rain events, causing large amounts of bacteria and sediment to flood into South Nolan Creek. The proposal for a bioswale in this area will decrease the bacteria levels through biofiltration and lower the risk of flooding by expanding the channel and increasing groundwater infiltration. The City Hall Building will demonstrate low impact design for the public serving as an outreach and education component of the project. This location is the central collection point for the western portion of Nolanville. During flood events this not only floods the streets but typically floods nearby residents. A bioswale, fitted to meet the metrics provided by Schiebe Consulting, will lower the flood risk for this area. Additionally, due to its proximity to the city's largest civic building, this location would serve as an educational and cultural asset, with educational signage, dog waste stations, and shady places to sit aside the tributary. The designers will incorporate a demonstration garden on this site, showing a series of small low-impact development strategies that improve non-point source pollution, including a filtered rain cistern and a biofiltration garden.

Area 3:

The third site (Area 3) is a bus stop located on Old Nolanville Road. The concrete bus pad sits atop a steep hill which leads directly to South Nolan Creek. During rain events this area sends

large amounts of sedimentation into the creek, leading to erosion of the hillside and heightened levels of debris in the creek. A bioswale in this area would slow water flow from the paved bus stop to South Nolan Creek, as well as create shade and cooling down the bus pad waiting area.

Area 4:

The final site is on South Main Street (Area 4), situated where Old Nolanville Road and South Nolan Creek intersect. Leading up to this site is a series of culverts with water collected from Main Street. This space currently serves as the terminus for the water collected but does not continue into South Nolan Creek due to grading issues. This has led to algal blooms, unpleasant odors, and occasional flooding of the surrounding areas. The proposal for a bioswale is to prevent current stagnation, thus reducing algal blooms, mosquito breeding, and flooding. This site will require a grading plan to allow for positive drainage into South Nolan Creek after being filtered. A bioswale with educational signage would be a regional benefit given that this area is a start point for bikers and runners throughout Central Texas.

Sustainability is the most important consideration in this project. The goal of low impact design is to reduce the strain on resources, but the measures could lose effectiveness if their benefit is not continuously highlighted. The City of Nolanville is prepared to ensure the enduring success of these measures through the following activities:

- The City will provide field trips from the elementary school annually in coordination with Earth Day events sponsored through Keep Nolanville Beautiful.
- Improvements will be marked with educational information.
- The improvements will also be integrated into State of the City address with tour of the community for City Officials.
- Information on the watershed, benefits and “how to” information will be highlighted on the City Website.
- Cost estimates for maintenance will be provided by the designers to ensure maintenance for up to 10 years is accounted for in the City’s budget.

With regard to readiness, the project has received support from Nolanville’s City Council and has a design team ready to proceed.

Cost for the completed project including installation and maintenance of bioswale, educational component, and load reduction measurements estimated at about \$217,000.

Appendix D

Educational Components within SWMPs

While not comprehensive, below are some of the education outreach components noted in SWMPs of entities within the watershed. Educational outreach for the Nolan Creek WAP expands beyond these ongoing efforts implemented within SWMPs.

Killeen

Educational Outreach as part of the City of Killeen's SWMP includes:

- At least 24 cable broadcasts of public service announcements with social media postings,
- Distribution within the KISD of 32,000 school book covers with stormwater related messages per year,
- Distribution of stormwater related brochures (some included on webpage) with targeting of business or locations to address specific issues,
- Utility bill inserts with stormwater related information (2 inserts mailed per year), and
- Storm drain stenciling focusing on older areas of the city known to be more problematic. (Stenciling of inlets involves student and community groups organized through KKB.)

Environmental Services Division webpage contains a link to the Killeen SWMP (<http://www.killeentexas.gov/index.php?section=113>). Also on the website are links to information regarding stormwater drainage, construction guidance, watershed announcements, some educational brochures, and other related information and links.

Killeen has an organized Storm Water Stakeholder Group that meets regularly that reviewed the SWMP and is involved with updates and review of the City's stormwater management practices.

Killeen SWMP specifically notes support of watershed organizations including the Lampasas River Watershed Partnership, outreach efforts dealing with Lake Stillhouse Hollow, and the Nolan Creek WPP efforts.

Harker Heights

As part of its SWMP, Harker Heights has a web presence devoted to stormwater quality to inform the public on issues by displaying educational brochures and other information related to protecting and improving stormwater quality including links to other pertinent sites (<http://www.ci.harker-heights.tx.us/index.php/storm-water>). The City of Harker Heights has a pet waste brochure developed with distribution focused on pet owners via pet stores, veterinarian clinics, pet adoptions, vaccinations drives and other pet-related events.

Nolanville

The Public Works webpage for Nolanville includes link to SWMP (http://ci.nolanville.tx.us/page/Department_Public_Works). The City of Nolanville in its SWMP

includes development of an Adopt-A-Stream program in partnership with the Killeen Independent School District (target date 2020).

Fort Hood

Department of Public Works –Environmental Division stormwater website contains downloadable brochures, links to educational websites, and other information to educate the Fort Hood community on the importance of keeping our stormwater clean. This stormwater website contains links to information regarding how Fort Hood is addressing each minimum control measure within its SWMP

(<http://www.hood.army.mil/dpw/Environmental/Municipal%20storm%20water.aspx>).

Bell County

The Bell County Storm Water Management webpage contains links to its SWMP and permit along with Public Education materials and IDDE program focusing on the costs of illegal dumping. Educational brochures are also to be distributed at various parks and boat ramps as part of Bell County's stormwater education program

(http://www.bellcountytexas.com/departments/engineer_2/storm_water_management.php). Bell County also sponsors the Bell County Annual Water Symposium through the Clearwater Underground Water Conservation District (<http://www.cuwcd.org/education/annual-water-symposium/>).