

Task 3.1 Management Measure Evaluation – Inventory and Evaluation of Existing Watershed Management Programs

(Based on Worksheet 10-1 in EPA Handbook for Developing Watershed Plans to Restore and Protect Our Waters)

Identifying Existing Management Efforts in the Nolan Creek/South Nolan Creek Watershed

Wastewater Discharges

What is the location and volume associated with wastewater discharges?

The location of wastewater treatment facility (WWTF) discharges are identified in Figure 1 and the associated permitted discharge in Table 1. This information is from “[Data Inventory for the Nolan Creek/South Nolan Creek Watershed Segment 1218ⁱ](#)” developed during the characterization project.

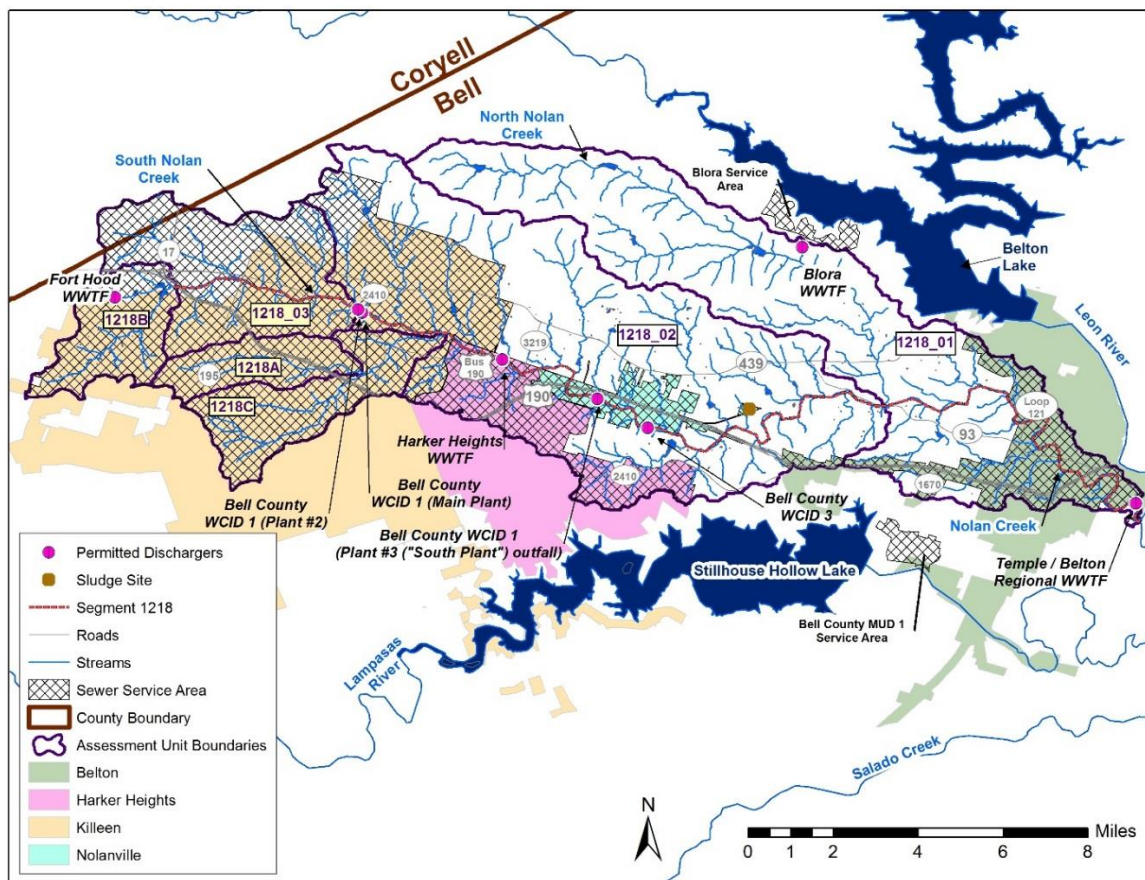


Figure 1 Location of wastewater discharges and service area for wastewater collection based on Certificate of Convenience and Necessity (CNN) and municipal boundaries within the Nolan Creek/South Nolan Creek watershed. Note: The service area for some dischargers extends beyond the watershed boundary, largely following municipal boundaries for the cities of Killeen and Harker Heights.

Table 1 Permitted WWTF within the Nolan Creek/South Nolan Creek watershed. Source: Texas Commission on Environmental Quality (TCEQ) Central Registry.

| Facility Name | Facility Location | Latitude | Longitude | EPA ID | Permit # | Permitted Discharge (MGD) |
|--|--------------------|------------|-------------|-----------|--------------|---------------------------|
| Temple Belton Regional WWTF | Belton, TX | 31.0432930 | -97.4386970 | TX0058378 | WQ0011318001 | 10 |
| Bell County Water Control & Improvement District (WCID) No. 3 WWTF | Nolanville, TX | 31.0690260 | -97.6050450 | TX0069191 | WQ0010797001 | 0.675 |
| City of Harker Heights WWTF | Harker Heights, TX | 31.0923330 | -97.6546730 | TX0024473 | WQ0010155001 | 3 |
| Bell County WCID No. 1 WWTF (Main Plant) | Killeen, TX | 31.1082780 | -97.7025070 | TX0024597 | WQ0010351002 | 18 |
| Bell County WCID No. 1 (Plant 2) | Killeen, TX | 31.1093070 | -97.7037850 | TX0102938 | WQ0010351003 | 6 |
| Bell County WCID No. 1 (Plant 3, South Plant) | Killeen, TX | 31.0788370 | -97.622790 | TX0125377 | WQ0014387001 | 6 |
| Universal Services Ft Hood WWTF | Ft Hood, TX | 31.1135080 | -97.7866860 | TX0101869 | WQ0013358001 | 0.09 |
| Belton Lake Outdoor Recreation Area (Blora) WWTF | Ft Hood, TX | 31.1305167 | -97.5523898 | TX0132446 | WQ0014994001 | 0.03 |

Parameters of concern in effluent – Bacteria measured as *Escherichia coli*

Existing permit requirements – Daily average *E. coli* 126 MPN/100 mL and daily maximum *E. coli* 400 MPN/100 mL

What is the recent (5-yr) compliance history of each permitted facility? What violations have occurred, how severe were these violations and what caused them?

Records for the monitoring period of Characterization project evaluated (May 2013 – June 2015). Information below from monitoring data report entitled “[Characterizing Water Quality within Nolan Creek/South Nolan Creek](#)”.

Reported *E. coli* concentrations from the WWTFs were generally below permit limits (Table 2). For daily average values, the permit limit for WWTFs is the same as the stream criterion for primary contact recreation of 126 MPN/100 mL. Only in August and September 2013 at the Bell County WCID1 Main Plant were any values reported above the daily average limit (Figure 2). The maximum daily *E. coli* limit for WWTFs is currently 399 MPN/100 mL. The daily maximum was reported as exceeded at the Harker Heights WWTF in December 2014 and May 2015 (Figure 3).

Table 2 Permitted and reported discharges and summary of reported *E. coli* concentrations from WWTFs. Source: Environmental Protection Agency (EPA) Enforcement and Compliance History Online (ECHO).

| Facility Name | TCEQ Permit # | Permitted Discharge (MGD) | Reported Discharge (MGD) May 2013-Jun2015 | Average of Average Reported <i>E. coli</i> (MPN/100 mL) May 2013 - Jun2015 | Maximum of Maximum Reported <i>E. coli</i> (MPN/100 mL) May 2013 - Jun2015 | Number of <i>E. coli</i> Obs. |
|---|---------------|---------------------------|---|--|--|-------------------------------|
| Universal Services Ft Hood WWTF | WQ0013358001 | 0.09 | 0.05 | 1 | 2 | 7 |
| Bell County WCID No. 1 (Plant 2) | WQ0010351003 | 6 | 0 | No data | No data | 0 |
| Bell County WCID No. 1 WWTF (Main Plant) | WQ0010351002 | 18 | 11.5 | 55 | 342 | 26 |
| City of Harker Heights WWTF | WQ0010155001 | 3 | 1.93 | 11 | 770 | 26 |
| Bell County WCID No. 1 (Plant 3, South Plant) | WQ0014387001 | 6 | 3.01 | 3 | 250 | 26 |
| Bell County WCID No. 3 WWTF | WQ0010797001 | 0.675 | 0.25 | 6 | 49 | 7 |
| Blora WWTF | WQ0014994001 | 0.03 | 0.01 | 1 | 3 | 8 |
| Temple Belton Regional WWTF | WQ0011318001 | 10 | 6.47 | 2 | 142 | 26 |

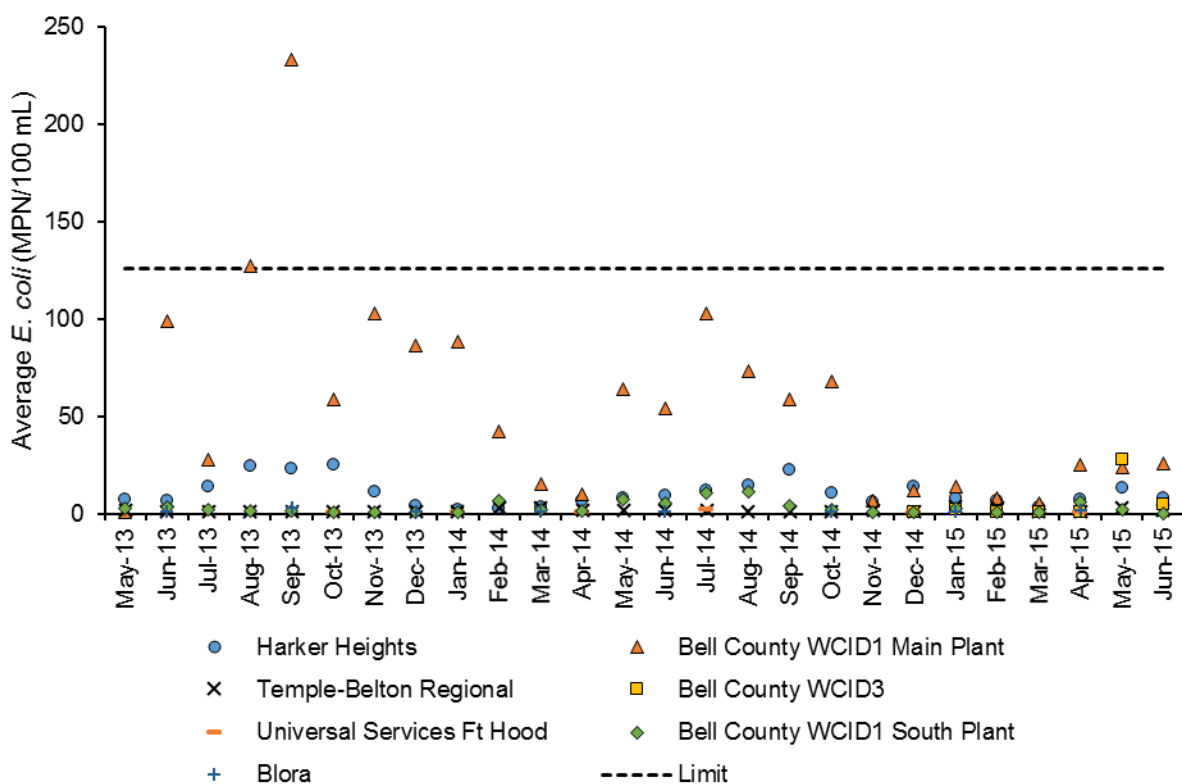


Figure 2 Reported daily average *E. coli* by month for WWTFs. Source: EPA ECHO.

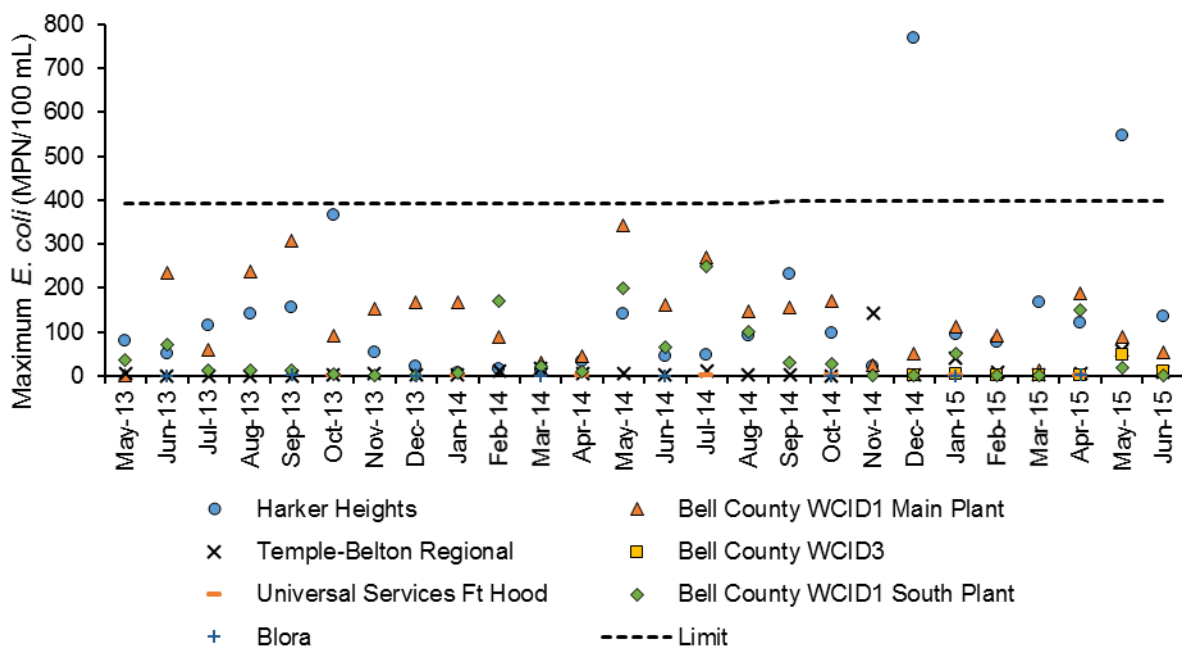


Figure 3 Reported daily maximum *E. coli* by month for WWTFs. Source: EPA ECHO.

Information on unauthorized discharges was obtained from TCEQ, and also directly from the City of Killeen (see Appendix A of “[Characterizing Water Quality within Nolan Creek/South Nolan Creek](#)”). The information on unauthorized discharges is known to be incomplete for the pertinent timeframe (May 2013-June 2015) due to delays in updates to the TCEQ database, but the available information provides an indication of on-going issues with sanitary sewer overflows (SSOs) most notably within the cities of Harker Heights and Killeen (Figure 4). Over 100 SSOs events were reported between May 2013 and June 2015. For the most part, these SSOs were relatively small with most discharges representing less than 200 gallons, and according to municipalities, all SSO events were cleaned and sanitized to mitigate the effect of each spill.

Most unauthorized discharges were associated with the backup of sewage lines caused by root balls or grease. There was a large spill (estimated 40,000 to 50,000 gallons) in July 2013 reported by the City of Killeen in which the backup of a sewer line cause overflow at a lift station.

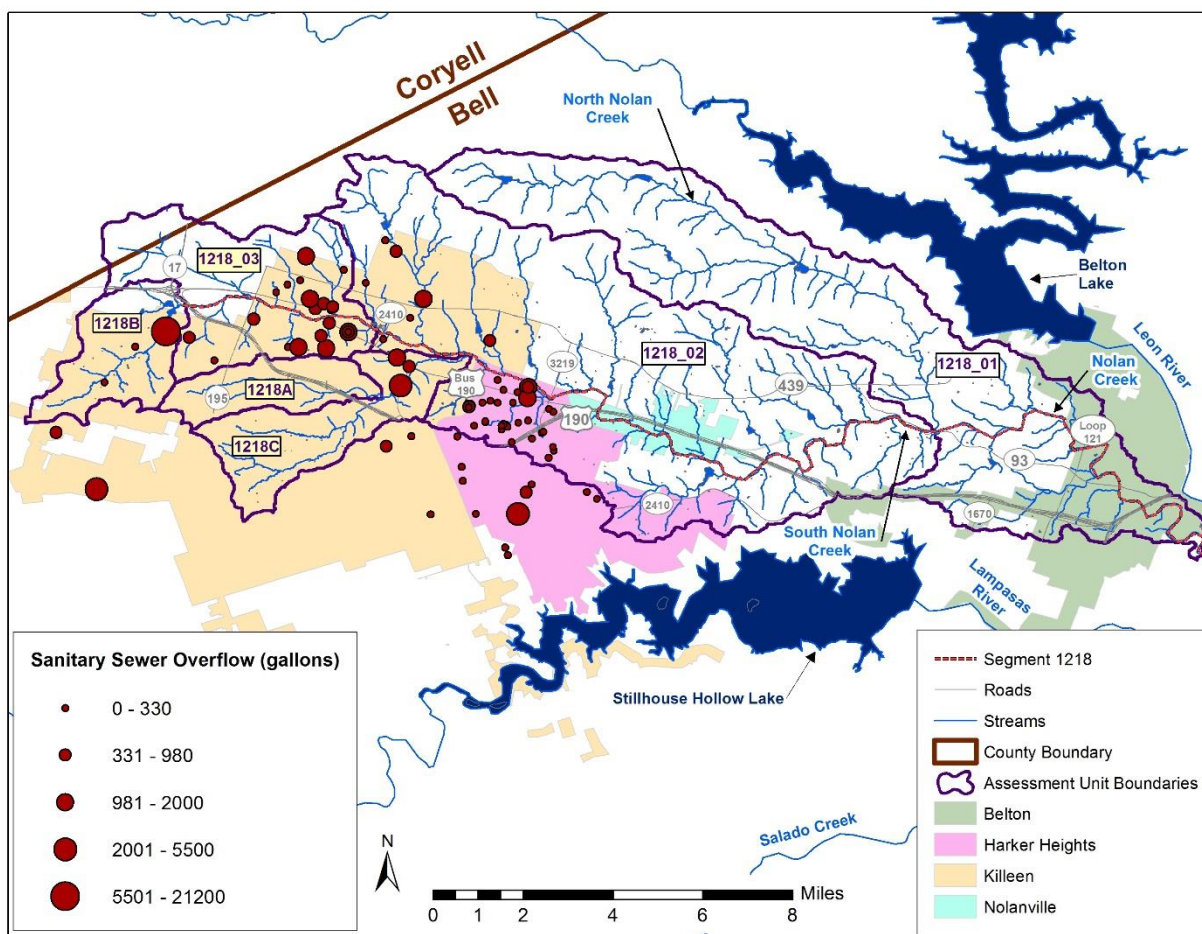


Figure 4 Location of reported unauthorized discharges within the Nolan Creek/South Nolan Creek watershed for the study period May 2013 through June 2015. Source: TCEQ and City of Killeen. Circles represent the relative size reported for unauthorized discharges.

Are significant treatment plant upgrades being planned?

No significant treatment plant upgrades are planned within the Nolan/South Nolan Creek watershed. However, as of August 27, 2015, the WCID 1, Plant #3 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 Bell County Water Control and Improvement District (WCID) No. 1 - Plant 3 facility, also known as the “South Plant”, is physically located south of the watershed on 8290 Chaparral Road in Killeen and will continue discharges 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 1, Plant #3, but the proportion of the discharge associated with each outfall is not specified in the permit.

What educational programs or ordinances address sewer line issues?

To address SSOs, the following activities are occurring:

City of Killeen – City Ordinances dealing with fats, oil and grease (FOG) in the sewer system (Chapter 30, Article III: Sewers and Sewage Disposal-FOG). Killeen website (<http://www.killeentexas.gov/index.php?section=126>) includes information on the impact of FOG in the sewer system as well as the following education downloads:

- Let’s Tackle the Grease in This Kitchen!
- How sewer blockage affects the sewer system
- Effective ways to dispose of household waste and contribute to a sustainable clean environment

City of Harker Heights – City Ordinance (§53.28 FATS, OILS AND GREASES; CONTROL AND PREVENTION) address FOG control and prevention.

The ENACTUS Club of Central Texas College has been very involved with “Operation Liquid Gold” involving reduction of FOG in the sewer system through an educational and community awareness campaign aimed at the collection and recycling of used cooking oil from residential and commercial settings. This educational program focuses its efforts around Thanksgiving, when many people may be using large amounts of cooking oil for frying turkeys. This program has led to the acceptance of used cooking oil at the Harker Heights Recycling Drop Center (http://kdhnews.com/harker_heights_herald/business/heights-center-to-expand-fog-recycling/article_595512a0-9ac4-11e3-86f5-0017a43b2370.html) as well as the recently opened Nolanville recycling center (22April2016, http://kdhnews.com/harker_heights_herald/local/nolanville-enactus-reveals-new-recycling-center-at-everything-day/article_849a259a-0809-11e6-956f-3f89fe0a6d3c.html).

Centex Grease Recovery is a commercial business in the area aimed at the free collection of used cooking oil from restaurants for use of this waste in producing bio-diesel.

The City of Belton has a recycling program focused on a large variety of materials, such as plastic, paper, cardboard and metal cans, with its residential garbage pickup but used cooking oil is not included. The Utility Operations Division of the Public Works Department in the City of Belton is charged with management of FOG within the city’s sewer infrastructure (<http://www.belontexas.gov/Index.aspx?NID=419>).

The educational efforts on FOG should continue and be supported. It appears there may also be a need within these areas to educate more about other sewer blockage issues, such as root-balls.

On-Site Wastewater Treatment Systems

Where are on-site systems located?

Within the Nolan Creek/South Nolan Creek watershed, the Bell County Health District deals with permitting of all new on-site sewage facilities (OSSFs). While there is tracking of new systems through the permitting process, older or “grandfathered” systems (generally prior to 1989) are sometimes difficult to track, because permits were not required for these. At this time, a complete inventory of OSSFs within the watershed does not exist and available information for most of the watershed is not in a format that is easily mapped. Some locations of OSSFs were made available by the City of Killeen in a GIS format as part of its Septic Tank Elimination Program (STEP) (Figure 5). The City of Killeen began STEP over 10 years ago to aid homeowners annexed into the city limits in moving from OSSFs onto the city’s central sewer collection system. For more information, refer to the “[Characterizing Potential Pollutant Loads to Nolan Creek/South Nolan Creekⁱⁱⁱ](#)” developed for the Characterization project.

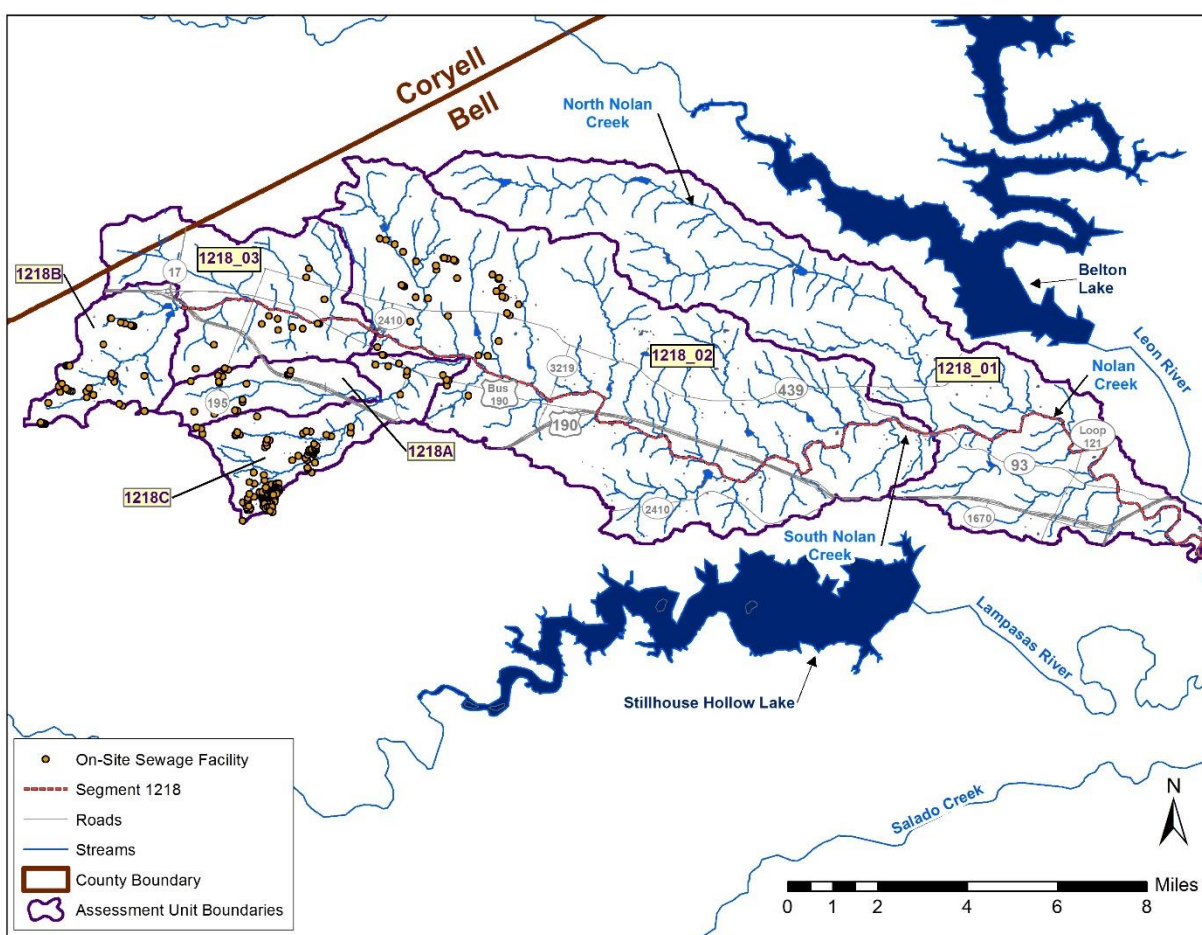


Figure 5 Location of some OSSFs within the Nolan Creek/South Nolan Creek watershed.
Source: City of Killeen.

Because there does not exist a complete inventory of OSSFs for the watershed, estimations were made using the Spatially Explicit Load Enrichment Calculation Tool (SELECT) by identifying areas not covered by a centralized collection system and overlaying that with 2010 Census data. Masking out the area serviced by sewer systems, about 2,180 households exist in the Nolan Creek/South Nolan Creek watershed that are expected to be on OSSFs. Information from the City of Killeen indicated an additional 273 households on OSSFs within its municipal boundaries (Figure 5). The estimated rural households in conjunction with the site-specific data provided by the City of Killeen were used in SELECT to estimate the density of OSSFs within each subbasin (Figure 6).

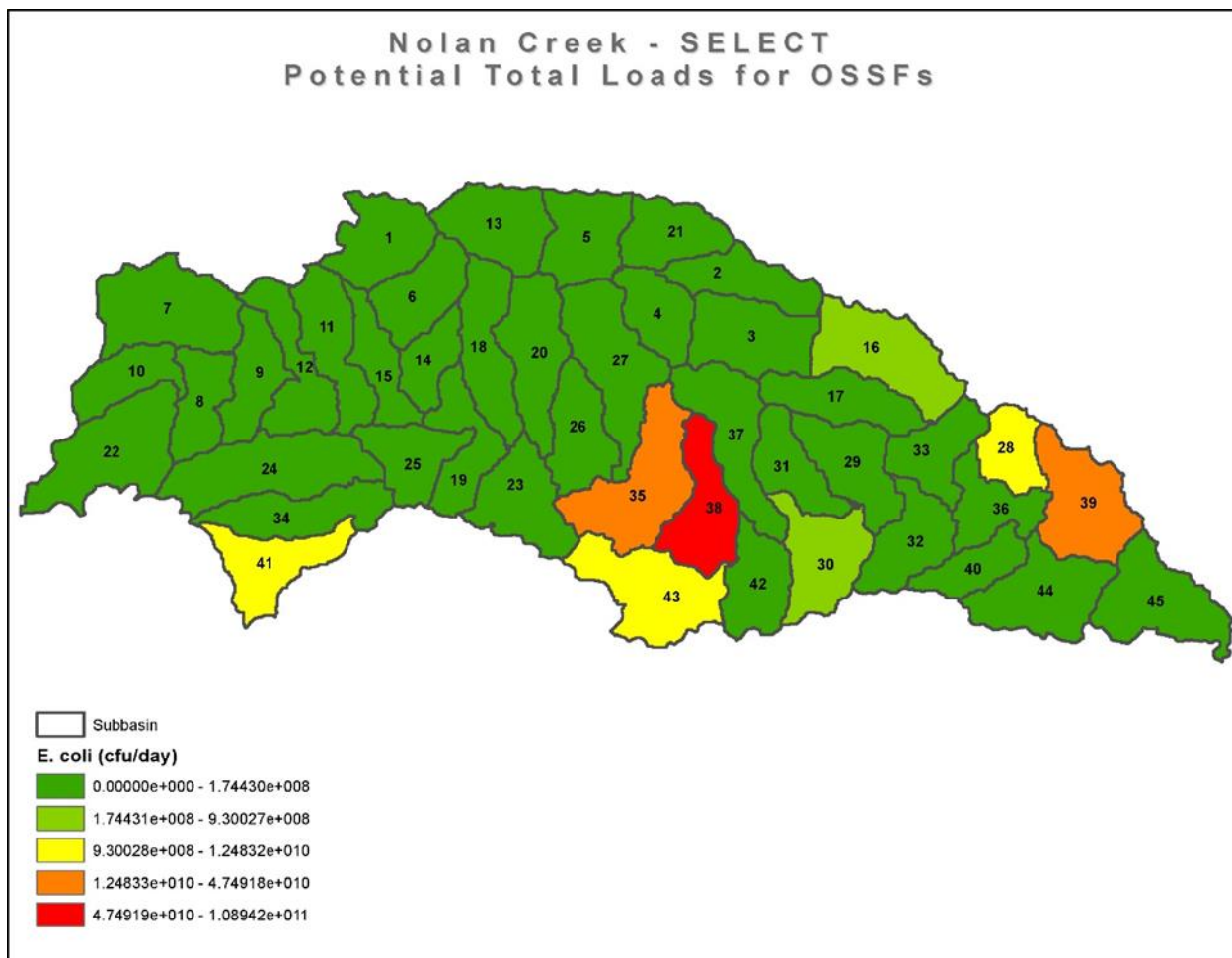


Figure 6 Distribution of potential *E. coli* loads from OSSFs by subbasin within the Nolan Creek/South Nolan Creek watershed using SELECT.

Are there known concentrations of failing on-site systems? If so, where?

While the number of failing systems within the Nolan Creek/South Nolan Creek watershed is difficult to estimate, it is a recognized problem based on the soils of the area.

Soils - According to the Bell County Soil Survey, soils within the watershed fall into two major associations; the Denton-Purves and the Speck-Tarrant-Purves. The majority of the watershed draining to South Nolan Creek is part of the Denton-Purves soil association, while the watershed

draining to North Nolan Creek and most of Nolan Creek is part of the Speck-Tarrant-Purves association. Both the Denton and Purves soil series are noted to have severe limitations for septic tank absorption fields based on shallow depth to bedrock (8 to 40 inches). The Denton series is noted for slow permeability. Severe limitations are noted for septic tank absorption fields for the three major soil series in the Speck-Tarrant-Purves association due to shallow depth to bedrock (8 to 20 inches) and slow permeability for the Speck soil series.

Is there a homeowners' education program for proper maintenance of on-site systems?
Educational materials and programs dealing with OSSFs are available through AgriLife Extension. Materials are available online at: <http://ossf.tamu.edu/onsite-wastewater-treatment-systems-owts/>. Events and workshops are scheduled across Texas dealing with maintenance of OSSFs and can be arranged upon request.

Is there an inspection program? If so, how often are they inspected?
Inspections occur for newly installed OSSFs during the installation process by the Bell County Public Health Department. Information is available online at: http://bellcountyhealth.org/environmental_health_and_food_protection/on-site_sewer_facilities/index.php. Once installed, proper maintenance is required, but further inspections generally are related only to septic complaints.

What is the depth of the water table?

- The watershed area occurs over the Trinity aquifer with water levels generally about 300 feet below the land surface. Bell County quarterly monitors the static water level of multiple wells and monitoring locations can be found at the following link: <http://www.cuwcd.org/aquifer-science/bell-county-monitor-wells/>.
- Seeps and springs exist in the watershed due to the karst limestone underlying much of the watershed. The City of Killeen has provided a brochure as part of their stormwater management education program to aid the public in differentiating groundwater seeps from water or sanitary sewer line leaks (http://www.killeentexas.gov/pdf/kpw/Seeps_n_Springs_brochure.pdf).
- The Clearwater Underground Water Conservation District holds an annual Water Symposium intended to share water related issues with residents and decision makers of Bell County (<http://www.cuwcd.org/education/annual-water-symposium/>). The timing of when this symposium occurs varies from year to year, but in most recent years (2013-2015), it has occurred in November or December.
- Drinking water for the watershed area comes primarily from Lake Belton as surface water to the cities of Killeen, Harker Heights, Nolanville and Belton.

Urban Stormwater Runoff

Are cities and counties covered by a Municipal Separate Storm Sewer System (MS4) permit? If so, what are the permit conditions?

Phase II permits are for smaller communities that are located within an "Urbanized Area". An "Urbanized Area" is defined by the U.S. Census Bureau as an area with populations greater than 50,000 and with an overall population density of at least 1,000 people per square mile as shown in Figure 7 for the watershed area.

Phase II MS4 permits:

- Bell County – TXR040055
- Killeen – TXR040010
- Harker Heights – TXR040011
- Belton – TXR040351
- Fort Hood Family Housing LP – TXR040317
- Nolanville – TXR040175
- Texas Department of Transportation Waco District (TxDOT) – TXR40199
- US Army Garrison Fort Hood – TXR040069

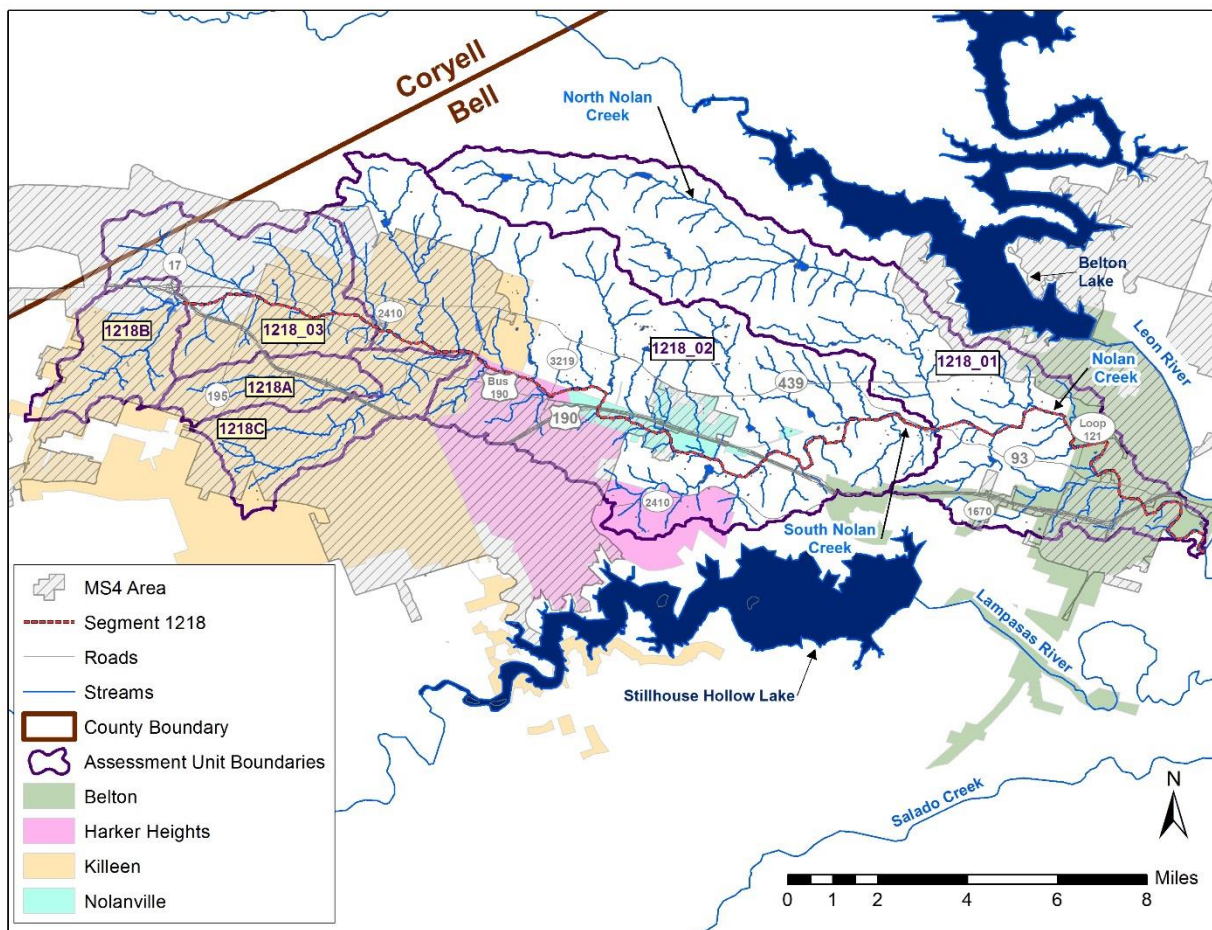


Figure 7 Location of MS4 areas within the Nolan Creek/South Nolan Creek watershed.
Source: 2010 Census Data of urbanized areas.

Within these MS4 permits, the entities with stormwater discharges along assessment units (AUs) 1218_02 and 1218C, as of the December 2013 General Permit under the Texas Pollutant Discharge Elimination System (TPDES) for Small MS4s, must address the impairment for bacteria. The City of Belton is the only entity with an MS4 area falls outside the impaired AUs. The MS4 General Permit indicates that if bacteria is a pollutant of concern, then the permittee shall include focused best management practices (BMPs) addressing sanitary sewer systems,

OSSFs (for entities with appropriate jurisdiction), illicit discharges and dumping, animal sources, and residential education.

Do local governments have stormwater ordinances and if so, what are their requirements?

Below are links to each of the local government's stormwater ordinances.

- Bell County - http://www.bellcountytexas.com/departments/engineer_2/storm_water_management.php
- City of Killeen - <http://www.killeentexas.gov/index.php?section=113>
- City of Belton - <http://www.beltontexas.gov/documentcenter/view/2734>
- City of Harker Heights - <http://www.ci.harker-heights.tx.us/index.php/storm-water>
- Fort Hood - <http://www.hood.army.mil/dpw/Environmental/Municipal%20storm%20water.aspx>

Do regulations address stormwater volume and pollutant loading?

Not specifically, although the MS4 permit requirements include identification of associated discharges for pollutants of concern and then development and implementation of focused BMPs for these sources. The stormwater management plans (SWMPs) for each MS4 permittee go into more detail as to how each is addressing concerns, particularly bacteria, within the watershed.

Does local government have a public education program for pollution prevention?

Affiliating with city governments gives synergy to efforts by the Nolan Creek/South Nolan Creek Partnership by partnering with efforts already in place. While there are other MS4 permittees in the watershed, the Cities of Killeen, Belton, and Harker Heights and Fort Hood have the most active educational/outreach programs as part of their MS4 permits (Tables 3 – 6). More in depth information can be found in the “[Outreach and Education Strategy for the Nolan Creek/South Nolan Creek Watershed^{1v}](#)” developed and completed during the characterization project.

Table 3 Best Management Practices to be implemented in the City of Killen in accordance with the City's MS4 permit.

| BMP | Implementation Activity | Measurable Goal | Implementation Date Goal |
|--|---|---|--------------------------|
| Public Service Announcements | <ul style="list-style-type: none"> • Broadcast stormwater messages on cable access channel • Develop new topic • Add Social Media postings for water quality | <ul style="list-style-type: none"> • 24 cable broadcasts • Copy of applicable Social Media postings | Begin Year 1 |
| Long Term Operations and Maintenance of BMPs | <ul style="list-style-type: none"> • Identify and catalog the permanent BMPs that have been implemented in Killeen in the past year | <ul style="list-style-type: none"> • List of public BMPs brought on line in the last year • Update Maintenance Schedule | Begin Year 1 |
| School Book Covers | <ul style="list-style-type: none"> • Select new design • Purchase book covers for Killeen Independent School District (KISD) | <ul style="list-style-type: none"> • 32,000 book covers purchased and distributed | Begin Year 1 |

| BMP | Implementation Activity | Measurable Goal | Implementation Date Goal |
|-------------------------|--|---|---------------------------------|
| Stormwater Brochures | <ul style="list-style-type: none"> • Produce and distribute 1 new brochure • Distribute existing brochures as needed • Evaluate process for distribution of outreach materials | <ul style="list-style-type: none"> • Number of brochures distributed • inventory of brochures | Begin Year 1 |
| Utility Bill Inserts | <ul style="list-style-type: none"> • Develop two inserts to be mailed with Utility Bill | <ul style="list-style-type: none"> • Copy of each insert • Number of inserts distributed | Begin Year 1 |
| Stormwater Website | <ul style="list-style-type: none"> • Publicize local and existing regional Household Hazardous Waste collection events • Publicize the Drainage Utility Response Line (hotline) • Update Drainage Utility web pages | <ul style="list-style-type: none"> • Screenshot of updated City web pages | Begin Year 1 |
| Stormwater Hotline | <ul style="list-style-type: none"> • Publicize Drainage Utility Response Line • Track complaint investigations from Response Line | <ul style="list-style-type: none"> • List of Investigations | Begin Year 1 |
| Stream Cleanup Projects | <ul style="list-style-type: none"> • Advertise program to organizations • Note potential locations during dry weather screening • Schedule and hold one cleanup event | <ul style="list-style-type: none"> • 1 summary flyer • Support 1 cleanup event | Begin Year 1 |
| Watershed Organization | <ul style="list-style-type: none"> • Support Outreach efforts for the Lampasas River Watershed Partnership, Lake Stillhouse Hollow Clean Water Steering Committee (LSHCWSC), Nolan Creek Watershed, Texas Stream Team | <ul style="list-style-type: none"> • Meeting Minutes from Agenda • Listing of how each entity was supported | Begin Year 1 |
| Storm Drain Stenciling | <ul style="list-style-type: none"> • Hold a stenciling event • Promote inlet marketing opportunities | <ul style="list-style-type: none"> • Update geographic information system (GIS) inlet map | Begin Year 1 |

Table 4 Best Management Practices to be implemented in the City of Belton in accordance with the City's MS4 permit.

| BMP | Measurable Goals | Implementation Date Goal |
|--|---|---------------------------------|
| Educate Residents | <ul style="list-style-type: none"> • Distribute public education materials regarding residential impacts on water quality | Begin Permit Year 1 |
| Educate Visitors to the Belton Area | <ul style="list-style-type: none"> • Distribute public education materials to visitors of the area detailing the importance of water quality and what the City is doing to promote the importance of water quality in the community. | Begin Permit Year 1 |
| Educate Commercial & Industrial Facilities | <ul style="list-style-type: none"> • Distribute literature to businesses that educate the importance of BMPs focusing on industrial, commercial and automotive business. • Develop recognition program that rewards businesses who lead by example in water quality efforts. | Begin Permit Year 2 |
| Educate Local Businesses | <ul style="list-style-type: none"> • Distribute literature to businesses through the Belton Chamber of Commerce Newsletter emphasizing the importance of BMPs for local businesses. • Develop recognition program that rewards businesses who lead by example in water quality efforts. | Begin Permit Year 3,4 |
| Educate New Developers/Home Builders | <ul style="list-style-type: none"> • Distribute literature to developers and homebuilders through the Temple Area Buildings Association Newsletter that educate the importance of BMPs on construction sites. • Evaluate and modify design standards and construction notes. | Begin Permit Year 2 |
| Educate Future Leaders | <ul style="list-style-type: none"> • Distribute literature, pencils, and other materials promoting the importance of water quality. • Promote an Art Contest promoting BMPs and water quality among students. | Begin Permit Year 1 |
| Public Notice in Development of SWMP | <ul style="list-style-type: none"> • Make the SWMP available for review and comments on the city website. | Begin Permit Year 1 |
| Illicit Discharge Awareness Campaign | <ul style="list-style-type: none"> • Develop training materials that detail the hazards associated with illicit discharges and improper disposal of waste. Develop and implement an illegal dumping notification link on the City website. | Begin Permit Year 1 |
| Social Media Outreach | <ul style="list-style-type: none"> • Identify most appropriate social media platform and distribute 12 informational posts annually regarding stormwater quality, environmental event schedules and water quality educational information. | Begin Permit Year 1 |

Table 5 Best Management Practices to be implemented in the City of Harker Heights in accordance with the City's MS4 permit.

| BMP | Measurable Goals | Implementation Date Goal | Frequency |
|---|--|---------------------------------|------------------------------|
| 1-1 Designate Storm Water Coordinator (SWC) | • Maintain SWC. | Begin Permit Year 1 | Yearly |
| 1-2 Stormwater Brochures | • Develop and distribute brochure on stormwater management every year. Maintain list of available brochures and distribution records. | Begin Permit Year 1 | Yearly |
| 1-3 Stormwater Website | • Continue to develop the stormwater page on the official City website. | Begin Permit Year 1 | Yearly |
| 1-4 Pet Waste Fact Sheet | • Distribute fact sheet through all pet stores and veterinarian offices, with all animal adoptions, and at pet-related events. | Begin Permit Year 1 | Yearly |
| 1-5 Outfall Signs | • Install outfall signs and labels and maintain existing ones. | Begin Permit Year 1 | Yearly |
| 1-6 Public Notification Compliance | • Submit a copy of the notice and publisher's affidavit to the TCEQ Chief Clerk. | Begin Permit Year 1 | Per TCEQ notice requirements |
| 1-7 Storm Drain Stenciling | • Contact youth and church groups. Stencil 25 catch basins and/or flumes per year throughout permit terms. | Begin Permit Year 1 | Yearly |
| 1-8 Stormwater Committee Meeting | • Maintain committee standing and track meeting attendance, agendas, topics of discussion, potential stormwater issues, initiatives and decisions. | Begin Permit Year 1 | Yearly |
| 1-9 Household Hazardous Materials Day | • Continue to hold an annual hazardous waste collection day. | Begin Permit Year 1 | Yearly |

Table 6 Best Management Practices to be implemented in Fort Hood in accordance with the base's MS4 permit.

| BMP | Measurable Goals | Implementation Date Goal | Frequency |
|----------------------|--|---------------------------------|------------------|
| 1-1 Training Courses | • Provide Environmental Compliance Officer (ECO) training course and document # of personnel trained. | Fully implemented | Monthly |
| 1-1 training courses | • Provide municipal operations Pollution Prevention (P2) training for appropriate employees and contractors, and document # of personnel trained. | Fully implemented | Semi-annually |
| 1-1 training courses | • Provide FOG training for dining facility and commercial restaurant staff and document # of personnel trained. | Fully Implemented | Quarterly |
| 1-1 training courses | • Provide construction general permit training course to Department of Public Works (DPW) and United States Army Corps of Engineers (USACE) staff, as well as, contractors and other operators, a document # of personnel trained. | Fully Implemented | Semi-annually |
| 1-2 Educational | • Provide posters on general stormwater awareness | Fully | Semi- |

| BMP | Measurable Goals | Implementation Date Goal | Frequency |
|-----------------------------------|---|---------------------------------|-------------------|
| materials | at key locations and document # of posters and sites utilized. | Implemented | annually |
| 1-2 Educational Materials | • Publish newspaper articles in the Fort Hood Sentinel and document # of newspapers that were distributed with the article. | Fully Implemented | Annually |
| 1-2 Educational Materials | • Provide handouts at the Community Services Council meeting and document # provided or # of personnel in attendance. | Fully Implemented | Annually |
| 1-2 Educational Materials | • Provide a stormwater awareness article for the newsletter for on-post residents and document the # of newsletters delivered. | Fully Implemented | Annually |
| 1-3 Environmental Outreach Events | • Provide educational handouts or a display or demonstration at various outreach events, and document # of student/public attending. | Fully Implemented | At least 4 a year |
| 1-4 Public Involvement | • Fort Hood will conduct annual spring and fall cleanup activities, and DPW will document the weight of trash and recyclables collected. | Fully Implemented | Semi-Annually |
| 1-4 Public Involvement | • Provide a facility and management of the Household Hazardous Waste (HHW) turn-in program, and document monthly inventories of materials both turned in and reissued. | Fully Implemented | Monthly |
| 1-5 Public Meetings | • Brief the Garrison Commander and other senior leadership on the status of the SWMP at the Environmental Quality Control Committee (EQCC), and document the information presented and personnel in attendance. | Fully Implemented | Annually |
| 1-5 Public Meetings | • Provide educational handouts for Community Services Council meeting. | Fully Implemented | Annually |
| 1-6 Public Website | • Review, maintain and update the municipal stormwater website, and document each review and any charges. | Fully Implemented | Semi-Annually |

Does local government have a stream restoration and BMP retrofit program? If so, what projects are being located in the watershed?

Stream restoration is not being addressed in this watershed, but with regard to BMPs, the long-term operation and maintenance of BMPs is part of each SWMP and maintenance schedule generally indicates annual updates.

Are any new ordinances or programs being developed or planned?

Stormwater ordinances are in place and reviewed annually to determine if updates are needed.

Agricultural & Forestry Practices (Questions for local NRCS & TSSWCB)

Are there areas with active farming or logging in the watershed?

Only about 1.4 percent of the watershed is comprised of cropland representing primarily oats, winter wheat and corn. Improved pasture also comprises less than 2 percent of the watershed area (Table 7). There is a fair amount of forested land in the northern portion of the watershed, although the majority is along North Nolan Creek, which is not part of the impaired assessment unit (Figure 8 and Table 9). According to local Natural Resource Conservation Service (NRCS)

personnel, commercial logging does not occur in the Nolan Creek/South Nolan Creek watershed, but rural land is used for pasture, range and cropland (mainly for hay).

Table 7 Land use/land cover for the Nolan Creek/South Nolan Creek watershed. Source: 2011 National Land Cover Database (NLCD).

| Category | Nolan Creek/South Nolan Creek Watershed (%) | Nolan Creek/South Nolan Creek Watershed (acres) |
|----------------------|--|--|
| Developed | 40.1 | 29,196 |
| Barren | 0.8 | 590 |
| Forest | 22.6 | 16,708 |
| Shrub/Scrub | 4.2 | 3,040 |
| Grassland Herbaceous | 26.8 | 19,517 |
| Pasture Hay | 1.5 | 1,072 |
| Cultivated Crops | 1.4 | 991 |
| Wetlands | 1.8 | 1,337 |
| Open Water | 0.5 | 360 |
| Totals | 100.0 | 72,811 |

There are no permitted concentrated animal feeding operations (CAFOs) in the watershed. Livestock estimates given in Table 8.

Table 8 Livestock estimates for the Nolan Creek/South Nolan Creek watershed. Based on 2012 Census of Agriculture for Bell County and 2011 NLCD.

| Category | Estimated Animals in Bell County | Associated Land Use/Land Cover (LULC) | Land Area in Bell County represented by LULC (acres) | Land Area in Nolan Creek/South Nolan Creek Watershed associated with LULC (acres) | Estimated Animals in Nolan Creek/South Nolan Creek Watershed |
|--|---|---|---|--|---|
| Cattle & Calves | 34,922 | Grassland Herbaceous & Pasture Hay | 274,658 | 20,589 | 2,618 |
| Sheep & Goats | 17,082 | Grassland Herbaceous, Pasture Hay, Shrubland & Forest | 396,342 | 37,297 | 1,607 |
| Horses & Ponies and Mules, Burros, & Donkeys | 3,735 | Grassland Herbaceous & Pasture Hay | 274,658 | 20,589 | 280 |

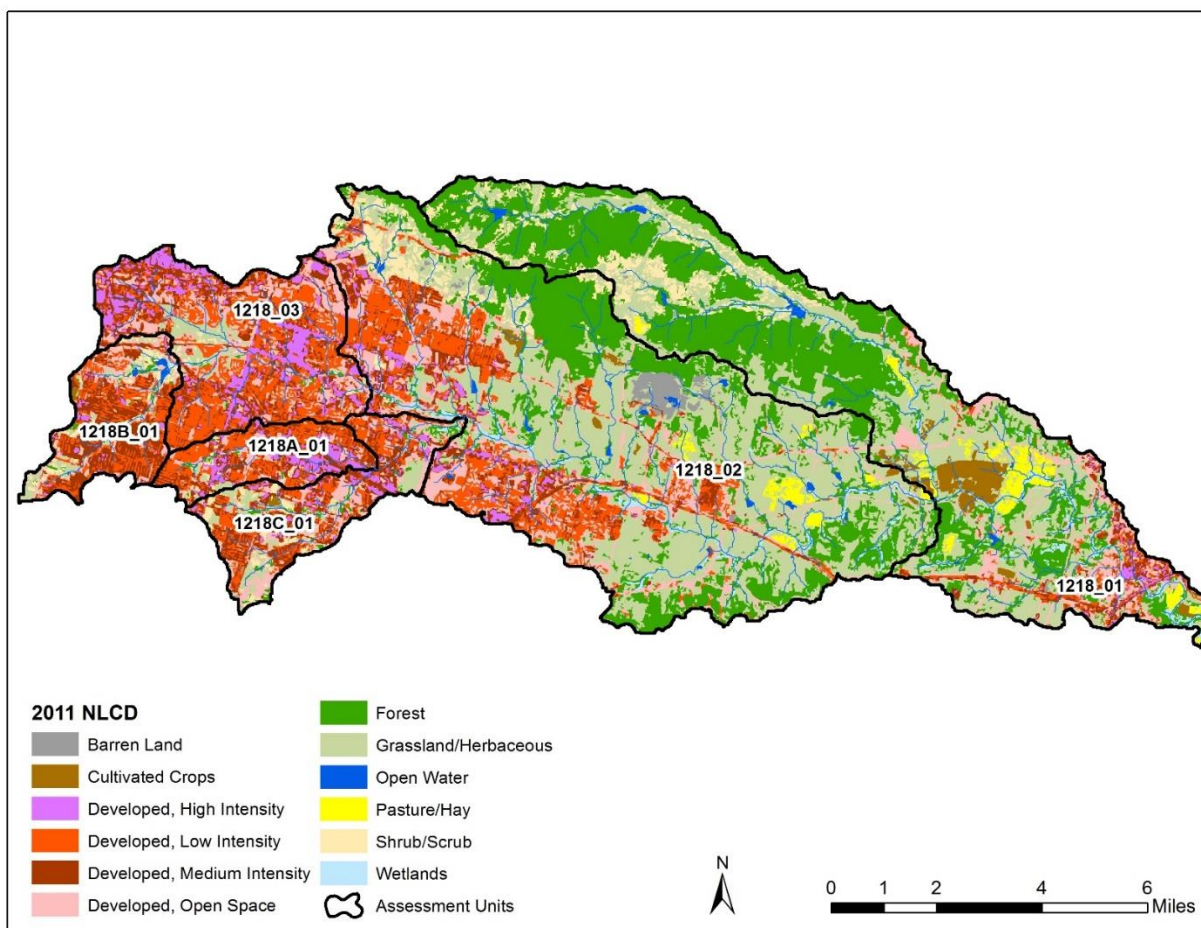


Figure 8 Land use/land cover for the Nolan Creek/South Nolan Creek watershed showing developed subcategories. Source: 2011 NLCD.

Table 9 Land use/land cover associated with each AU within the Nolan Creek/South Nolan Creek watershed. Source: 2011 NLCD.

| Land Use/Land Cover Category | 1218_01 | 1218_02 | 1218_03 | 1218A | 1218B | 1218C |
|------------------------------|---------|---------|---------|-------|-------|-------|
| Barren Land | 0.1% | 1.8% | 0.0% | 0.0% | 0.1% | 0.3% |
| Cultivated Crops | 3.3% | 0.5% | 0.0% | 0.0% | 0.7% | 0.5% |
| Developed | 13.3% | 32.1% | 93.6% | 94.2% | 79.9% | 76.6% |
| Forest | 41.9% | 21.4% | 0.4% | 1.3% | 1.9% | 4.2% |
| Grassland/Herbaceous | 29.3% | 36.8% | 5.0% | 2.5% | 8.2% | 12.0% |
| Open Water | 0.6% | 0.5% | 0.0% | 0.0% | 1.2% | 0.0% |
| Pasture/Hay | 2.9% | 1.3% | 0.0% | 0.0% | 0.0% | 0.0% |
| Shrub/Scrub | 5.9% | 3.3% | 0.8% | 1.9% | 7.7% | 5.9% |
| Wetlands | 2.6% | 2.2% | 0.1% | 0.1% | 0.3% | 0.5% |

Are management plans in place where these agricultural activities are occurring?

The Natural Resource Conservation Service (NRCS) was asked via email on August 18, 2016 about active agricultural management plans in the Nolan Creek watershed. The local district conservationist responded that there might be for highly erodible lands (HEL) used for cropland, hayland or pasture. A current summary of HEL areas is not readily available from NRCS, but could be developed if considered important to the WPP effort. Due to confidentiality issues with landowners, the data provided would just be summary information for the watershed.

What percent of the area has management plans in place?

The Texas State Soil and Water Conservation Board (TSSWCB) was queried on September 8, 2016 regarding active water quality management plans (WQMPs) in the Nolan Creek/South Nolan Creek watershed. The TSSWCB responded that they currently have no WQMPs in the Nolan Creek/South Nolan Creek watershed.

What types of management practices are most commonly used for controlling sediment and other pollutants?

According to the watershed's local district conservationist with the NRCS, known common practices in Bell County include brush management, forage and biomass planting, herbaceous weed control, range planting, nutrient management, and prescribed grazing.

What are obstacles to the implementation of best management practices (BMPs)?

As previously stated, only about 1.4 percent of the watershed is comprised of cropland and cultivated crops. Most of the Nolan Creek/South Nolan Creek watershed is urban with roughly 40 percent of the watershed comprised of developed land (Table 7). Feedback from NRCS noted that larger land holdings are being sold into smaller properties and subdivisions. This division of the land into smaller holdings would be considered an obstacle to the implementation of BMPs, because it increases the number of landowners that need to be worked with as well types of BMPs needed (rural agriculture vs. ranchettes that may need more urban type BMPs).

Are there existing stream side buffers? If so, how wide?

According to an NRCS representative, there are no known stream side buffers sponsored by NRCS or the Central Texas Soil Water Conservation District (SWCD) in the watershed.

Wetlands & Critical Habitat Protection

Have wetlands been identified? If so, have they been evaluated for their habitat value, water quality benefits, and flood control contributions?

Wetlands based on the land use information are very limited within the watershed and primarily located along the stream corridor. These wetland areas have not been specifically evaluated for their benefits. Of note, for flood control, there are several small reservoirs that have been developed in the watershed (Figure 9).

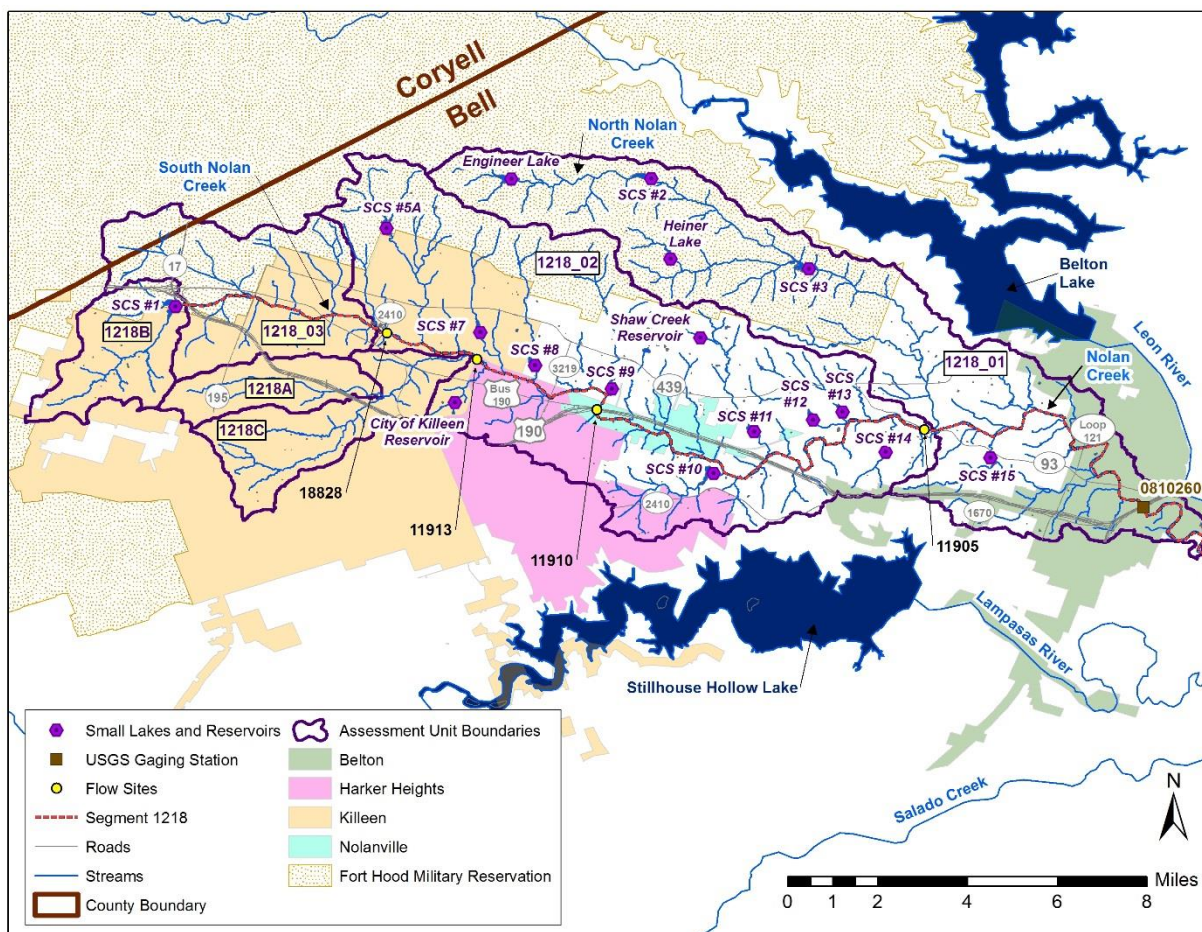


Figure 9 Location of hydrologic features within the Nolan Creek/South Nolan Creek watershed.

To what extent do natural buffers and floodplains remain in the watershed?

Natural buffers and floodplains appear to be very limited along the mainstem within urban portions of the watershed. Some comments from more downstream landowners that urbanization has increased flows leading to more bank erosion and loss of property.

Have there been any projects to create or restore wetlands?

No.

To what extent are critical habitats such as headwater streams, seeps, and springs being protected?

Unknown.

Has the natural hydrologic connectivity of the stream system been mapped?

Yes.

Are there any fragmentations in the stream network? If so, are there management practices occurring to decrease this fragmentation?

There does not appear to be any fragmentation of the stream network.

Identification of Program Needs and Opportunities

Because much of the watershed area is covered under small MS4 permits, many of the program needs are already being addressed under SWMPs. There is more that should be done, and from the above inventory and discussions with stakeholders, the main gaps in program needs and opportunities are as follows:

- Education of the public in general on the specific bacteria issue associated with Nolan Creek/South Nolan Creek, what it means with regard to recreational water usage and what individuals can do to help improve water quality.
- Updates on monitoring of water quality in various locations to assist the public in understanding their risk in using the waters for recreational activities with regard to bacteria.
- Educational efforts focused on homeowners with on-site wastewater treatment systems, particularly new homeowners who have bought homes where there is an existing on-site system.
- Assisting in more specifically identifying locations and sources within the watershed of bacteria loadings.
- Educational efforts focused at landowners in the rural areas on small acreages that may have animals (e.g., livestock or horses) where proper disposal of animal waste may be an issue.
- Assistance to landowners along the creek with streambank erosion problems. As the headwaters of the watershed has developed with more urban land uses, downstream landowners along Nolan Creek/South Nolan Creek have indicated increased streambank erosion problems.
- Education of the public on the impacts of feeding of wildlife, particularly in park areas, on water quality.
- Assisting education efforts in dealing with pet waste as a major potential contributor to bacteria issues within the urban portion of the watershed. While city ordinances address proper disposal of waste and the one dog park in the watershed has waste disposal stations, there is still a need to get people to understand the importance of picking up and properly disposing of pet waste.
- Within stakeholder discussions, connections to the centralized wastewater system, particularly in high-density areas, such as mobile home parks.

More specific education and outreach activities are outlined in Table 10, as previously presented in the “[Outreach and Education Strategy for the Nolan Creek/South Nolan Creek Watershed](#)” report for the Characterization project.

Table 10 Proposed outline of education and outreach activities.

| Outreach Activity | Host &/or Delivery Agency | Proposed Number of Programs or Items | | |
|--|--|--------------------------------------|-----------|------------|
| | | Years 1-3 | Years 4-6 | Years 7-10 |
| Nolan Creek Partnership Outreach - Awareness & Informational Materials | | | | |
| Website | Nolan Creek Partnership | 1 | 1 | 1 |
| Fact Sheet | | 1 | 1 | 1 |
| Newsletters | | 3 | 3 | 3 |
| Brochures | | 1 | 1 | 1 |
| Fliers | | 4 | 4 | 4 |
| Signage | | | 3 | 3 |
| Displays at Local Events | | 8 | 12 | 12 |
| Regional Nonpoint Source Pollution Educational Programs | | | | |
| Texas Watershed Steward Training | Nolan Creek Partnership & Cities (host) with Texas AgriLife with Texas Water Resource Institute (TWRI) (delivery agency) | 1 | | |
| Texas Stream Team Training | Nolan Creek Partnership & Cities (host) with Texas Stream Team (delivery agency) | 2 | 2 | 2 |
| Septic System Workshops | Nolan Creek Partnership & Cities (host) with Texas AgriLife with TWRI (delivery agency) | | 1 | 1 |
| Riparian Proper Functioning Condition Training | Nolan Creek Partnership & Cities (host) with Texas Riparian Association (delivery agency) | | 1 | 1 |
| Public School Educational Program | Nolan Creek Partnership & Cities (host & delivery agency) | | 2 | 2 |
| Agricultural Nonpoint Source Pollution Educational Programs | | | | |
| Nutrient Management | Nolan Creek Partnership (advertising & supporting) with Texas AgriLife (delivery agency) | | 2 | 2 |
| Soil & Water Testing | | | 2 | 2 |
| Livestock Grazing Management Education | | | 2 | 2 |

| Outreach Activity | Host &/or Delivery Agency | Proposed Number of Programs or Items | | |
|---|--|--------------------------------------|-----------|------------|
| | | Years 1-3 | Years 4-6 | Years 7-10 |
| Agricultural Waste Pesticide Collection Events | Nolan Creek Partnership (hosting) with TCEQ (delivery agency) | | 1 | 1 |
| Lonestar Healthy Streams | Nolan Creek Partnership (hosting) with Texas AgriLife (delivery agency) | | 1 | 1 |
| Feral Hog Management Workshop | Nolan Creek Partnership (hosting) with Texas AgriLife (delivery agency) | | 1 | 2 |
| Whitetail Deer Management Workshop | Nolan Creek Partnership (hosting) with Texas AgriLife (delivery agency) | | 1 | 2 |
| Urban Nonpoint Source Pollution Educational Programs | | | | |
| Pet Waste | Nolan Creek Partnership (advertising & supporting) with Cities, Texas AgriLife, Centex Sustainable Communities Partnership (hosting) | | 1 | 1 |
| Illegal Dumping | | | 1 | 1 |
| Fats, Oil, Grease | | | 1 | 1 |
| Sports & Athletic Field Education | | | 1 | 1 |
| Low Impact Development | | | 1 | 1 |
| Urban Nutrient Management | | | 1 | 1 |
| Stormwater BMP Demonstrations | | | 1 | 1 |
| Local Government Maintenance Education | | | 1 | 1 |
| Stream Cleanup Events | Nolan Creek Partnership & Cities (advertising & supporting) with Keep Texas Beautiful (hosting) | | 1 | 1 |
| Recreationalist Anti-Litter Campaign | Cities & County (Hosting) | | 1 | 1 |
| Storm Drain Inlet Marking Events | Cities (Hosting) | | 1 | 1 |

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- i [http://t-nn.tarleton.edu/docs/nolan_creek/publications/Nolan_Data_Inventory_Report\(revDec2015\)FINAL.pdf](http://t-nn.tarleton.edu/docs/nolan_creek/publications/Nolan_Data_Inventory_Report(revDec2015)FINAL.pdf)
 - ii [http://t-nn.tarleton.edu/docs/nolan_creek/publications/Nolan_Monitoring_Report\(revDec2015\)FINAL.pdf](http://t-nn.tarleton.edu/docs/nolan_creek/publications/Nolan_Monitoring_Report(revDec2015)FINAL.pdf)
 - iii [http://t-nn.tarleton.edu/docs/nolan_creek/publications/Nolan_LDC_SELECT_Report\(18Feb2016\)FINAL.pdf](http://t-nn.tarleton.edu/docs/nolan_creek/publications/Nolan_LDC_SELECT_Report(18Feb2016)FINAL.pdf)
 - iv [http://t-nn.tarleton.edu/docs/nolan_creek/publications/Outreach%20and%20Education%20Strategy_Final\(19Feb2016\).pdf](http://t-nn.tarleton.edu/docs/nolan_creek/publications/Outreach%20and%20Education%20Strategy_Final(19Feb2016).pdf)