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Final Report for Section 319(h) Nonpoint Source Grant

Assessment and Targeting of Bacterial Sources in the South Nolan Creek Watershed

October 2008

Final Report

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Assessment and Targeting of Bacterial Sources in the South Nolan Creek Watershed

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List of Abbreviations

Ag – Silver
As – Arsenic
AU – Assessment Unit
Ba – Barium
BMP – Best Management Practice
BOD5 – Biochemical Oxygen Demand, 5-day
Cd – Cadmium
cfs – Cubic Feet per Second
CFU – Colony Forming Units
Cond – Specific Conductance
Cr – Chromium
Cu – Copper
DEM – Digital Elevation Model
DMR – Discharge Monitoring Report
DO – Dissolved Oxygen
EMC – Event Mean Concentration
EPA – Environmental Protection Agency
ETJ – Extraterritorial Jurisdiction
I & I – Inflow and Infiltration
LOQ – Limit of Quantitation
MCM – Minimum Control Measure
MGD – Million Gallons per Day
mg/L– Milligrams per Liter
Mn – Manganese
MPN – Most Probable Number
MS4 – Municipal Separate Storm Sewer System
Ni – Nickel
NOI – Notice of Intent
NO2+NO3-N – Nitrate + Nitrite Nitrogen
NH3-N – Ammonia Nitrogen
NWS – National Weather Service
OPO4-P – Orthophosphate Phosphorus
OSSF – On-Site Sewage Facility, commonly referred to as septic tanks
O&G – Oil and Grease
Pb – Lead
Se – Selenium
SSO – Sanitary Sewer Overflow
SWMP – Storm Water Management Program
TKN – Total Kjeldahl Nitrogen
TCEQ – Texas Commission on Environmental Quality
TIAER – Texas Institute for Applied Environmental Research
TMDL – Total Maximum Daily Load
TSS – Total Suspended Solids, also called Total Nonfiltrable Residue
TSWQS – Texas Surface Water Quality Standards
Temp – Water Temperature
TN – Total Nitrogen
TP – Total Phosphorus
TPDES – Texas Pollutant Discharge Elimination System
TSS – Total Suspended Solids
USDA – United States Department of Agriculture
USGS – United States Geological Survey
WCID – Water Control and Improvement District
WWTP – Wastewater Treatment Plant
Zn – Zinc
µg/L – Micrograms per Liter

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Executive Summary

The City of Killeen has taken a proactive approach in addressing water quality problems to improve the quality of life for citizens of Killeen. The City initiated a water quality monitoring program in the South Nolan Creek watershed to identify priority sub-basins where bacteria concentrations exceed State water quality standards and target these areas for implementation of Best Management Practices (BMPs). Monitoring within the City of Killeen characterized the water quality in the upper 6.9 miles of the 29 mile long segment (Segment 1218), which extends from its origin in Killeen to its confluence with the Leon River.

Water quality monitoring for the project was initiated in October 2006 and continued through February 2008. The project was completed in August 2008. Results of routine and wet-weather monitoring were used to identify priority areas in the City for on-site sewage facility (OSSF) inspections, sewer conversions through the City's Septic Tank Elimination Program, targeted public education programs and dry weather screening. This assessment project addressed water quality indicators that are typically associated with urban non-point sources including: E. coli bacteria, nutrients, biochemical oxygen demand, oil/grease, metals, suspended solids and physical properties such as water temperature, pH, dissolved oxygen, and specific conductance. With the exception of bacteria, ambient monitoring was conducted semi-annually at five main stem stream sites on the South Nolan Creek. Bacteria monitoring was conducted on a monthly basis at nine sites and included six sites on the South Nolan Creek and three tributary sites. Wet-weather monitoring was conducted at a single site where the South Nolan Creek leaves the City of Killeen and enters Harker Heights to characterize pollutant Event Mean Concentrations. Nine storm events were monitored during the study.

The 6.9 mile reach of the South Nolan Creek that was monitored during this study was divided into an Upper Reach (4 miles), a Middle Reach (1.1 miles) and a Lower Reach (1.8 miles) based on the water quality monitoring results.

- The Upper Reach from the beginning of Segment 1218 to a point immediately upstream of the Bell County wastewater treatment plant (WWTP) outfalls was characterized as meeting the designated uses and showed no impairments related to the Texas Surface Water Quality Standards (TSWQS). Dissolved oxygen (DO), pH, temperature, nutrients, metals and bacteria concentrations met the TSWQS criteria and screening levels set by the Texas Commission on Environmental Quality (TCEQ).
- The Middle Reach met TSWQS criteria for DO, pH, temperature, metals and bacteria concentrations. Nutrient concentrations (ammonia, nitrate plus nitrite, orthophosphorus, and total phosphorus) above TCEQ screening levels were observed immediately downstream of the WWTP outfalls. While not conclusive, several water quality parameters as well as flow data suggest that the WWTP discharge may be the source of elevated nutrients. The final report recommends that a special study be conducted by TCEQ to confirm the source of elevated nutrients.
- The Lower Reach met TSWQS criteria for DO, pH, temperature, and metals. Nutrient concentrations generally declined but remained elevated above TCEQ screening levels.

Elevated bacteria concentrations were observed and the number of exceedances and the geometric mean confirm impairment of the contact recreation use due to OSSF influences from Long Branch and Little Nolan Creek.

The results showed a positive relationship between the E. coli geometric mean concentration and the number of OSSFs located above the sampling site. Based on the monitoring results and watershed characteristics such as land use, soils, hydrography, and OSSF densities, the City identified four priority sub-basins for BMP implementation.

- The Little Nolan Creek and Little Nolan Creek Tributary 1 sub-basins were identified as high priority for implementation of the City's Septic Tank Elimination Program. These sub-basins contain 301 of the 451 OSSFs located in the South Nolan Creek watershed.
- The Long Branch sub-basin was identified as high priority for implementation of targeted public education relating to septic tank maintenance and proper pet waste management.
- The Bermuda Ditch sub-basin contains no known OSSFs but occasional dry weather flows were observed with elevated E. coli concentrations. The City will use dry weather screening techniques to identify possible sources, which may include illicit discharges and illegal connections to the storm sewer system.

The City will implement these BMPs through its Phase II Municipal Separate Storm Sewer System (MS4) Storm Water Management Program. The City plans to continue ambient monitoring for E. coli concentrations at 3 sites (SN-2, SN-8 and SN-9) on a quarterly basis to monitor long-term trends and characterize water quality improvements and BMP effectiveness.

1.0 Introduction

The City of Killeen is located in Bell County in Central Texas. Storm water runoff from the City's urbanized area drains to three classified segments in the Brazos River Basin: South Nolan Creek (Segment 1218), the Lampasas River (Segment 1217) and Stillhouse Hollow Lake (Segment 1216). The South Nolan Creek receives storm water runoff from the northern portion of the City while the Lampasas River and Stillhouse Hollow Lake receive storm water from the southern portion of the City of Killeen.

1.1 Purpose and Scope of Work

The purpose this project was to address water body impairments that have been documented for South Nolan Creek and to determine the extent to which the City of Killeen may be contributing to the water quality problems. This project focused on the portion of the South Nolan Creek located within the Killeen city limits. This equates to the upper 6.9 miles of the 29 mile long segment (Segment 1218). Results of routine and wet-weather monitoring were used to identify priority areas in the City for on-site sewage facility (OSSF) inspections, sewer conversions through the City's Septic Tank Elimination Program, and targeted public education programs. This assessment project addressed water quality indicators that are typically associated with urban non-point sources including: E. coli bacteria, nutrients, biochemical oxygen demand, oil/grease, metals, suspended solids and physical properties such as water temperature, pH, dissolved oxygen, and specific conductance.

Four major objectives were identified in the work plan for the project as defined below.

OBJECTIVE 1: PROJECT ADMINISTRATION

Goal: To effectively administer the functions necessary to coordinate and monitor all work performed for the 319 grant project including technical and financial supervision, preparation of status reports and maintenance of project files and data.

Progress reports were submitted quarterly to the Texas Commission on Environmental Quality (TCEQ) and documented all activities performed by the City of Killeen and subcontractors. Quarterly reimbursement forms and Small and/or Minority Owned Business Reports were also submitted to TCEQ. The City participated in annual project review meetings and contractor evaluations and prepared annual updates to the Quality Assurance Project Plan (QAPP).

OBJECTIVE 2: WATER QUALITY MONITORING & DATA COLLECTION

Goal: To quantify nonpoint source pollutants within the South Nolan Creek watershed and through analysis of the data, identify priority areas within the City of Killeen for BMP implementation related to bacterial sources.

This objective included an inventory of the potential sources within the watershed, site identification, installation of automatic samplers for wet-weather monitoring, and initiation of a

routine monitoring program. Monitoring efforts and data collection were conducted by the City of Killeen with assistance from subcontractors. Prior to initiation of sampling, the City developed a QAPP that was approved by TCEQ and the Environmental Protection Agency (EPA).

OBJECTIVE 3: WATERSHED CHARACTERIZATION

Goal: To obtain information on potential sources of bacteria in the watershed and to characterize the nature of bacterial sources above each sampling site.

The City characterized the location of potential pollutant sources in the watershed, particularly those sources related to bacteria. A GIS-based coverage was developed of On-Site Sewage Facilities (OSSFs), sanitary sewer overflows (SSOs), and land use based sources in the watershed. The watershed characteristics were used in conjunction with the monitoring results to target priority areas in the watershed for BMP implementation.

OBJECTIVE 4: FINAL REPORT

Goal: To provide TCEQ and EPA with a comprehensive report on the activities conducted by City of Killeen during the course of this project.

The City consolidated water quality and watershed characteristics into a database and used graphical and statistical techniques to summarize the data and examine relationships and trends in the data. The City identified four priority areas for BMP implementation as part of their Phase II Municipal Separate Storm Sewer System (MS4) Storm Water Management Program (SWMP). This report serves as the deliverable for Objective 4.

1.2 Water Quality Impairments and Concerns

Nolan Creek/South Nolan Creek (Segment 1218 of the Brazos River Basin) extends 29 river miles from the confluence with the Leon River in Bell County to a point 100 meters upstream of the upper-most crossing of US 190 and Loop 172 in Bell County. Designated uses for South Nolan Creek include high aquatic life use, contact recreation use, general use, and fish consumption use.

The 2008 Texas Water Quality Inventory and 303(d) List prepared by TCEQ identifies several pollutants of concern for which the segment is either impaired or has sufficient exceedances of water quality standards criteria to be a concern. The segment is impaired (i.e., not supporting) with respect to the contact recreation use due to elevated bacteria levels. The segment was first listed on the State's 303(d) List in 1996 and was classified in Category 5c. A classification of Category 5c indicated that the TCEQ felt that more data were needed before a Total Maximum Daily Load (TMDL) analysis would be scheduled. The 2006 303(d) list (issued on June 27, 2007) changed the status for the segment to Category 5a, which indicates that a TMDL will be scheduled for the stream segment.

In addition to the 303(d) listing of Segment 1218 for bacteria, surface water quality assessments have also identified South Nolan Creek as having a nutrient enrichment concern. Nutrients,

specifically nitrate, orthophosphorus, and total phosphorus, have been identified as a concern due to concentrations above TCEQ screening levels.

1.3 Water Quality Standards and Screening Levels

For each of the designated uses that a water body is determined to have, a set of specific water quality criteria are imposed by TCEQ in the Texas Surface Water Quality Standards (TSWQS). Water quality criteria relevant to the South Nolan Creek are listed in **Table 1**.

Table 1. Water Quality Criteria

Segment ID	Water Body Name	Chloride[1] (mg/L)	Sulfate[1] (mg/L)	Dissolved Solids[1] (mg/L)	Dissolved Oxygen[2] Minimum (mg/L)	Min pH[3]	Max pH[3]	E.Coli[4] (CFU/100mL)	Fecal Coliform[4] (CFU/100mL)	Temperature[5] Maximum (F)
1218	Nolan Creek / South Nolan Creek	100	75	500	5	6.5	9	126	200	93

[1] Chloride, sulfate and dissolved solids criteria are expressed as a maximum annual average
[2] Dissolved oxygen criteria relates to the minimum 24-hour mean
[3] pH criteria are set for the minimum and maximum values expressed in standard units
[4] E. coli and Fecal Coliform expressed as the geometric mean in CFU/100mL
[5] Temperature criteria is the maximum value allowed any site within the segment

TCEQ uses screening levels in the absence of numeric nutrient criteria to identify concerns associated with the narrative criteria. The screening levels for nutrients are the same statewide but vary depending on the type of water body. The TCEQ has established screening levels for freshwater streams, reservoirs, tidal streams and estuaries. The screening levels that are applicable to the South Nolan Creek monitoring are listed in **Table 2**.

Table 2. Narrative Criteria (TCEQ Screening Levels) for Nutrients

Water Quality Parameter	Screening Level
Ammonia Nitrogen (mg/L)	0.17
Nitrate plus Nitrite Nitrogen (mg/L)	2.76
Orthophosphate Phosphorus (mg/L)	0.5
Total Phosphorus (mg/L)	0.8

2.0 Water Quality Indicators

There are several major water quality constituents that are used as indicators of water quality. Through monitoring and review of these constituents, determinations and classifications are made regarding the quality of the water. The major constituents used to determine water quality in the South Nolan Creek Watershed are discussed below.

<u>E. Coli</u>

Escherichia coli (E. coli) is a subgroup of fecal coliform bacteria that occurs naturally in the intestinal tract and feces of warm-blooded animals and humans. The presence of E. Coli bacteria is used to indicate the human health risk from harmful microorganisms present in water. The water

quality criteria adopted by TCEQ for waters used for contact recreation limit the concentration of E. coli to no more than 126 cfu/100 mL. Additionally, single samples should not exceed 394 cfu/100 mL of E. coli.

Dissolved Oxygen

Oxygen is essential for the life processes of most aquatic organisms. Low concentrations of dissolved oxygen (DO) can indicate the presence of excessive organic loads in the system or very low flow conditions, while high values can indicate excessive plant production. Many aquatic organisms will suffocate if there is insufficient volume of dissolved oxygen in the water.

Oxygen is consumed by the respiration of aquatic plants and fish and replenished by reaeration from the atmosphere and by plant photosynthesis. Photosynthesis requires sunlight and occurs during the daylight hours. Dissolved oxygen concentrations, therefore, follow a cyclic daily pattern with the lowest concentrations occurring during the early morning hours after the nighttime consumption of oxygen when plants have not been replenishing the oxygen through photosynthesis. DO concentrations generally peak during mid-afternoon hours, due the effect of plant photosynthesis, which may result in supersaturation.

Because dissolved oxygen is critical to healthy fish populations, the State of Texas has established requirements for dissolved oxygen as part of their TSWQS (**Table 3**). The minimum DO concentration that the State has set as water quality standards is linked to the designated use of the water body. Each water body in the State is designated as exceptional, high, intermediate, limited, or no significant aquatic life use based on the physical, chemical and biological characteristics of the water body. The minimum DO criteria established for each aquatic life use are listed below. The minimum DO criteria established by the State are written in terms of 24-hour average concentrations and absolute minimums. Single (instantaneous) DO measurements must not fall below the minimum value and the average concentration over a 24-hour period must not fall below the average value for the water body to support its aquatic life use designation. The South Nolan Creek is designated for “High” aquatic life use; therefore, DO concentrations must be 5 mg/L or greater (24-hr mean DO) and must not fall below a minimum of 3 mg/L to meet surface water quality standards.

Table 3. Dissolved Oxygen Criteria for Aquatic Life Uses

Aquatic Life Use	24-Hour Mean DO Concentrations	Absolute Minimum DO
Exceptional	6 mg/L	4 mg/L
High	5 mg/L	3 mg/L
Intermediate	4 mg/L	3 mg/L
Limited	3 mg/L	2 mg/L
No Significant	2 mg/L	1.5 mg/L

Nutrients (Nitrogen and Phosphorus)

Nitrogen

Nitrogen compounds occur naturally in surface water and may take the form or nitrate, nitrite, ammonia, or organic nitrogen. Organic nitrogen is formed during the decay of organic matter (i.e., plant and animal tissue) and is broken down by soil bacteria into simpler, inorganic forms of nitrogen such as nitrite, nitrate and ammonia. In streams and lakes, nitrogen compounds are continually being recycled between organic and inorganic forms.

Major urban sources of nutrients include pet waste, municipal wastewater treatment plant discharges, septic discharges and commercial fertilizer applied to lawns. Human and animal wastes tend to contain more nitrogen in the organic form as compared to commercial fertilizer, which tends to be composed of inorganic forms of nitrogen. Rainwater is also considered a source of nitrogen; however, atmospheric deposition is generally a minor contributor.

Aquatic plants form the base of the food chain and require inorganic nitrogen for growth. Although some amount of nitrogen is required to support a healthy plant and fish community, excessive amounts of nitrogen can encourage the growth of nuisance aquatic plants such as algal blooms. Algal blooms may become so dense that they produce "pea" green water and form a mat of filamentous algae at the water surface. Beyond the aesthetic degradation caused by the color and clarity of the water, the excessive algae endanger the whole ecosystem and can lead to massive fish kills. Fish kills are generally the result of low dissolved oxygen that occurs after the algae have died and decomposition begins to consume the oxygen. However, some fish kills can result from the algae themselves. Some algae can produce toxins that are deadly to fish. Algae blooms can also lead to unpleasant taste and smells. Certain species of algae produce by-products that create an offensive taste and odor in the water, which, if used for a public drinking water supply, may be costly to correct.

Phosphorus

Phosphorus is a plant nutrient that can encourage the growth of nuisance aquatic plants such as algal blooms. As a result, high levels of phosphorus can also lead to insufficient dissolved oxygen levels and fish kills. Phosphorus can come from municipal sewage treatment discharges or runoff from the land within the watershed. Phosphorus is usually considered the limiting factor (the required nutrient that is present in the lowest quantities) that controls the amount of algal growth in a water body. When the algae are phosphorus-limited, the addition of nitrogen will not cause the algae to multiply because there is not sufficient phosphorus. On the other hand, a small addition of phosphorus can cause a rapid growth of algae (i.e., bloom).

Total phosphorus is the sum total of the various phosphorus compounds present in the water and is expressed in milligrams per liter. The phosphorus compounds can be divided into organic phosphorus and inorganic phosphorus. Inorganic phosphorus (orthophosphate) is the form used by aquatic plants and algae for growth. Organic phosphorus will eventually be broken down by bacteria into orthophosphate and can stimulate the growth of algae over a longer time frame than orthophosphate.

Orthophosphate phosphorus is the chemical form of phosphorus that is readily consumed by aquatic plants and can contribute to rapid algal growth. Under phosphorus-limited conditions, the addition of small quantities of orthophosphate phosphorus to a water body can lead to algal blooms, low dissolved oxygen, and fish kills. Phosphorus may also be responsible for eutrophication. Eutrophication is the term used by scientists to describe the accelerated aging of a water body. As water bodies naturally age they become shallower, more turbid and more productive (they produce more plant and fish biomass). The addition of nutrients, primarily phosphorus, leads to accelerated aging; subsequently, the water body is termed eutrophic. The TCEQ uses screening levels to assess water quality concerns relative to phosphorus.

The State does not currently have specific numeric criteria for nutrients (nitrogen and phosphorus) within the TSWQS. As mandated by the EPA, the states must develop nutrient criteria as part of their water quality standards. Until the nutrient criteria are developed and adopted, the TCEQ will rely on screening criteria to determine when nutrients are a concern for a particular water body.

Metals

High concentrations of metals can pose a threat to human health when present in drinking water supplies. Beside the ingestion of dissolved metals in the water, bioaccumulation of these compounds in fish tissue can also pose a health risk. Potentially dangerous levels of these substances are identified through chemical analysis of water, sediment, and fish tissue.

Metals can also be lethal to fish and other aquatic organisms. The TSWQS contain specific criteria for metal concentrations to protect aquatic life uses. Criteria are specified as maximum concentrations for chronic (long-term) exposures and acute (instantaneous) exposures to metals. Human health criteria are also specified for maximum metals concentrations in water and fish tissue.

3.0 Watershed Characteristics

The South Nolan Creek Watershed within the Killeen city limits was delineated based on the United States Geological Survey (USGS) Digital Elevation Model (DEM) data. The watershed encompasses 26,589 acres and was divided into 9 smaller sub-basins that represent the drainage area above each sampling site (**Figure 1**). The sub-basins are denoted based on the sampling site that is located immediately downstream. For example, the SN-4 sub-basin is the sub-basin located upstream of site SN-4. The total watershed affecting water quality at site SN-4 includes all upstream sub-basins so the total watershed influence at site SN-4 is from sub-basins SN-4, SN-5, SN-6 and SN-7.

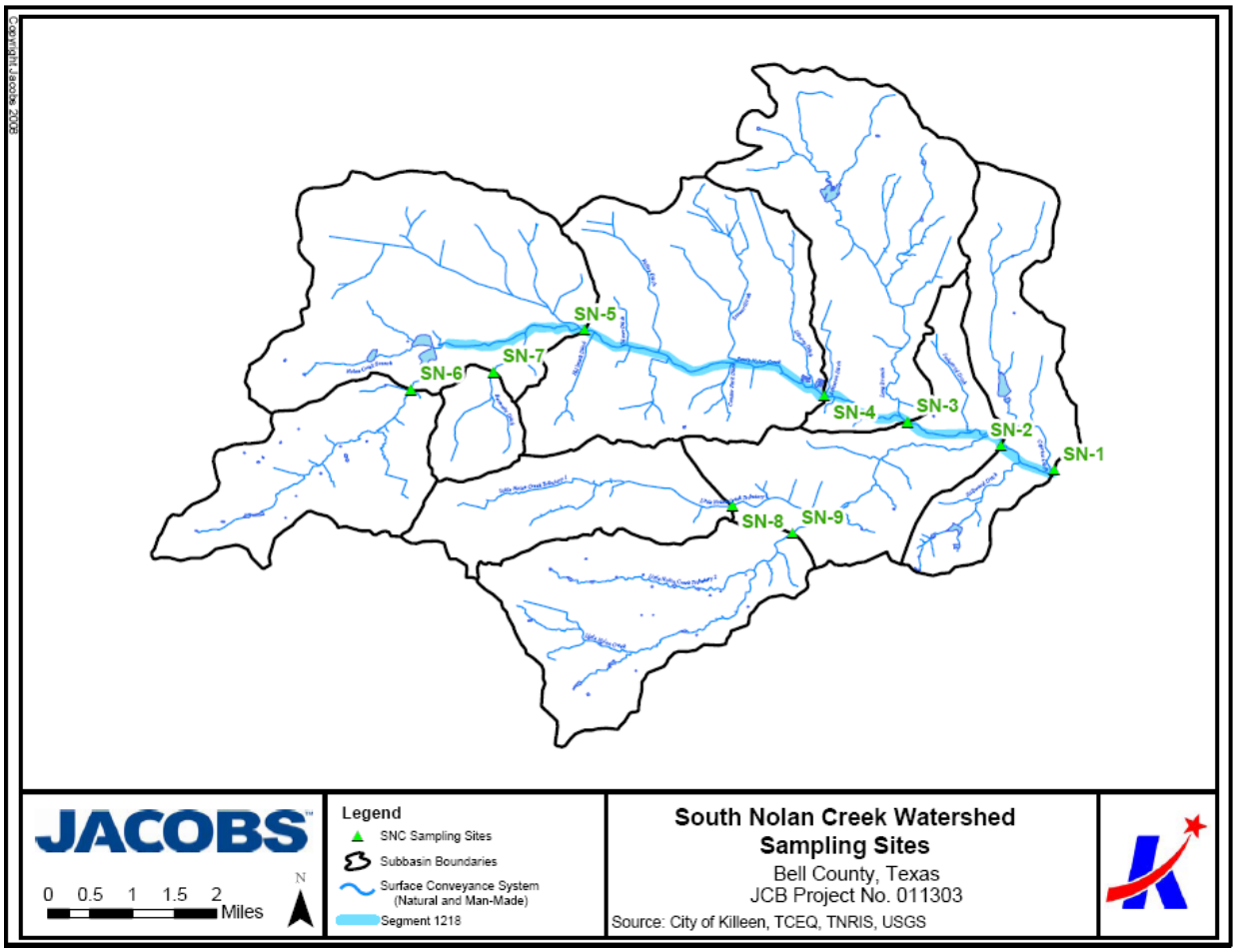

Figure 1. South Nolan Creek Watershed and Sub-Basins

The sub-basins range in size from 632 acres to 4,723 acres (**Table 4**).

Table 4. Sub-Basin and Watershed Acreage

Sub-Basin ID	Sub-Basin Area (Ac)	Total Watershed Area above Sampling Site (Ac)
SN-1	2,448	26,589
SN-2	2,703	24,141
SN-3	4,220	16,348
SN-4	4,723	12,128
SN-5	4,414	7,405
SN-6	2,359	2,359
SN-7	632	632
SN-8	2,006	2,006
SN-9	3,084	3,084
Total	26,589	

3.1 Population and Demographics

According to the 2000 U.S. Census data, the City of Killeen experienced a 36 percent growth in population from 1990 to 2000, exceeding the state-wide average of 23 percent. This growth is primarily attributed to the increase in military personnel at the nearby Fort Hood military base. Killeen's economy is closely tied to Fort Hood. Over 50 percent of the area's jobs are associated with the military base. Killeen's 2007 population was estimated at 107,015, a 23 percent increase since 2000. Recently, an additional 5,000 U.S. troops and their families relocated to the Killeen/Fort Hood area (CTEC, 2007). The population of Killeen reflects a diverse community, which includes individuals of White (46%), African American (34%), Hispanic/Latino (18%), Asian (4%) and Native American (1%) backgrounds (U.S. Census Bureau, 2000).

3.2 Ecoregion

The South Nolan Creek Watershed is located in the Cross Timbers Level III ecoregion (**Figure 2**). The Level III Cross Timbers ecoregion is further divided into five Level IV ecoregions (Eastern Cross Timbers, Western Cross Timbers, Grand Prairie, Limestone Cut Plain and Carbonate Cross Timbers). The South Nolan Creek Watershed is located in the Limestone Cut Plain Level IV ecoregion. This ecoregion is characterized by mesas that alternate with broad intervening valleys in a stairstep topography that is underlain by Lower Cretaceous limestones. The Limestone Cut Plain has a flatter topography, lower drainage density, and a more open woodland character than the Balcones Canyonlands to the south. The vegetation of the ecoregion includes post oak, white shin oak, cedar elm, Texas ash, plateau live oak, and bur oak. Although the grasslands of the Limestone Cut Plain are a mix of tall, mid, and short grasses, it is considered the westernmost extension of the tallgrass prairie, which distinguishes this ecoregion from the Edwards Plateau Woodland. This ecoregion includes grasses such as big bluestem, little bluestem, yellow Indiangrass, silver bluestem, Texas winter grass, tall dropseed, sideoats grama, and common curly mesquite.

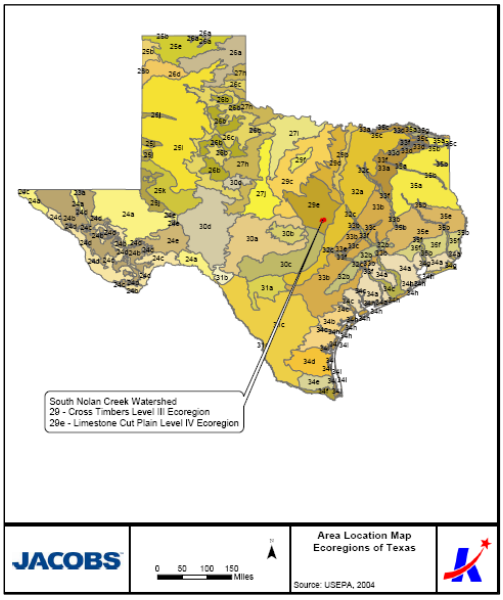

Figure 2. Ecoregions of Texas

3.3 Climate

The climate of Bell County is humid subtropical and is characterized by hot dry summers. Tropical maritime air controls the climate during spring, summer and fall. During the winter and early spring, the area experiences frequent surges of Polar Canadian air that causes sudden drops in temperature. Precipitation is fairly evenly distributed throughout the year and averages 33.87 inches annually (USDA, 1971). The driest months are generally July and August.

Average monthly high temperatures for the area range from 104.3º F in August to 78.4º F in January (USDA, 1971). Prevailing winds in the area are southerly with the strongest perisistent

winds occurring in March and April.

Two National Weather Service (NWS) climatological stations are located in the South Nolan Creek Watershed (**Figure 3**). Both stations record temperature, barometric pressure, dew point, precipitation, wind speed and wind direction. The Fort Hood Weather Station (WBAN ID 03933) is a daily recording station with a period of record from May 1946 to present. A second NWS station located at the Killeen Municipal Airport (WBAN ID 03972) records hourly measurements and has been in operation since 1967. The City compiled weather data from the National Climatic Data Center for both weather stations in the watershed for the monitoring period (October 2006 – February 2008). Monthly precipitation data for the Fort Hood Weather Station is presented in **Figure 4**.

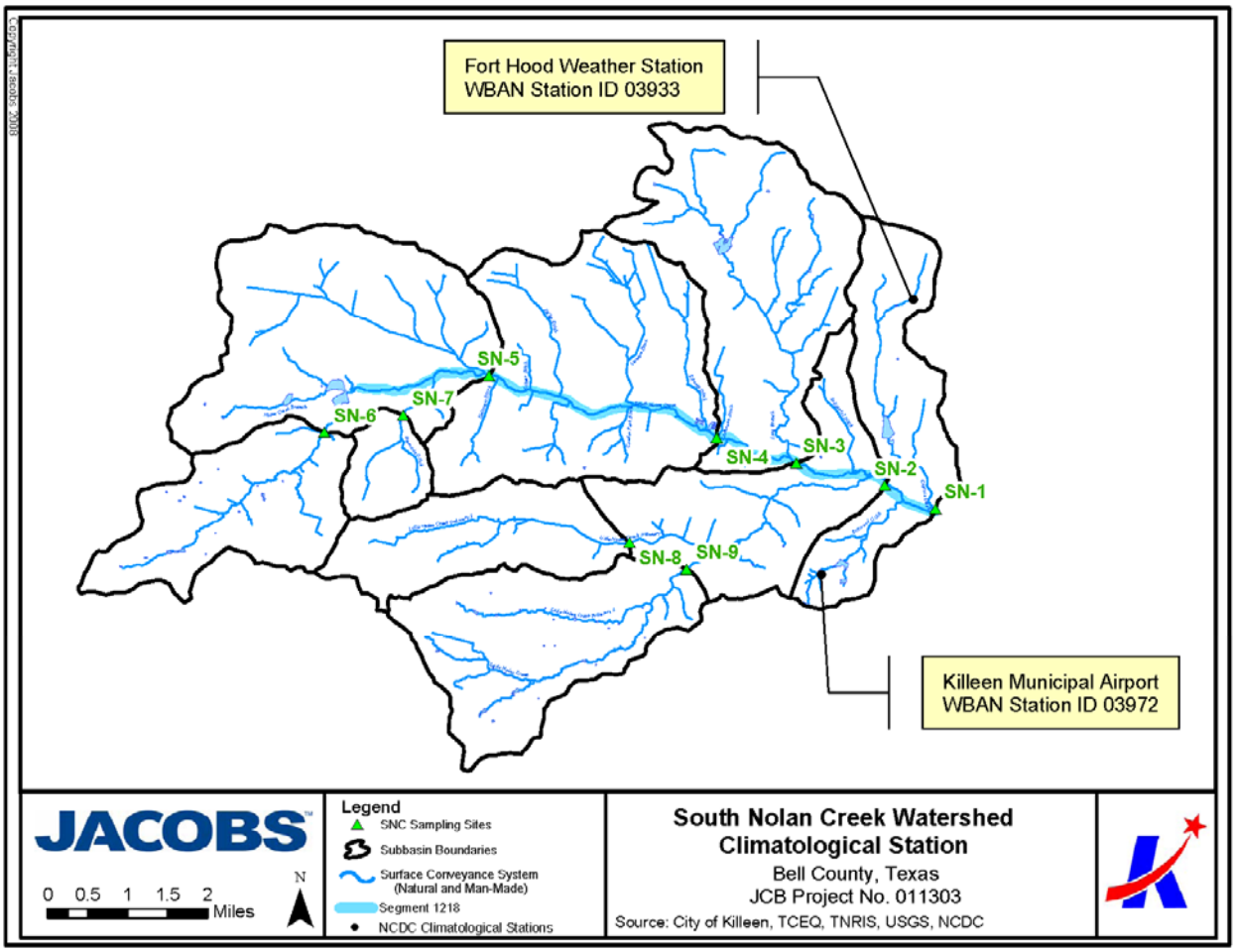

Figure 3. NWS Climatological Stations in the Watershed

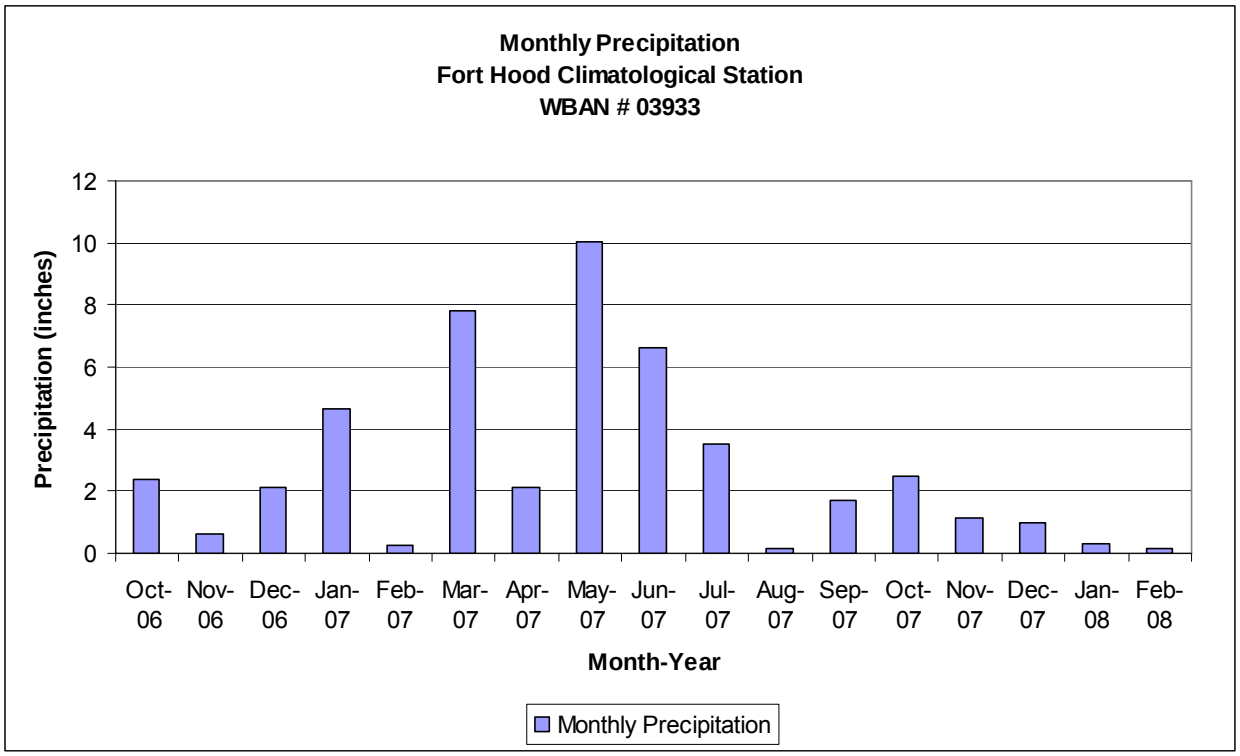

Figure 4. Monthly Precipitation for the Monitoring Period

3.4 Soils

Area soils are primarily clays and silty clays. Within the South Nolan Creek Watershed over 60 percent of the soils are silty clays. A total of seven different soil types make up 80 percent of the soils in the watershed. The dominant soil type is Denton silty clay, comprising 20% of watershed, followed by Purves silty clay, Topsey clay loam and San Saba clay. **Figure 5** depicts the percentages of different soil types in the South Nolan Creek Watershed. The aerial distribution of soils within the watershed and sub-basins is depicted in **Figure 6**.

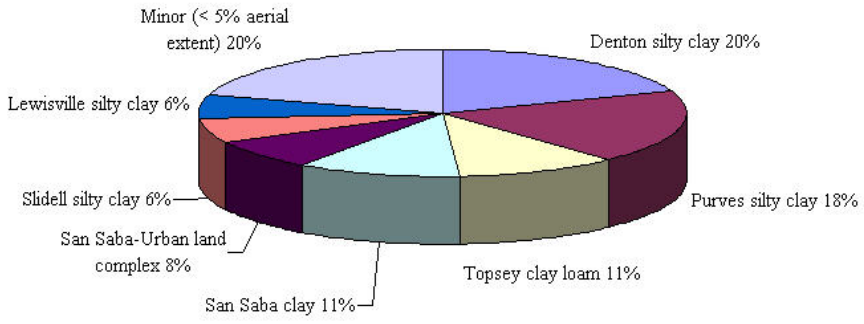

Figure 5. Composition of Soils in the South Nolan Creek Watershed

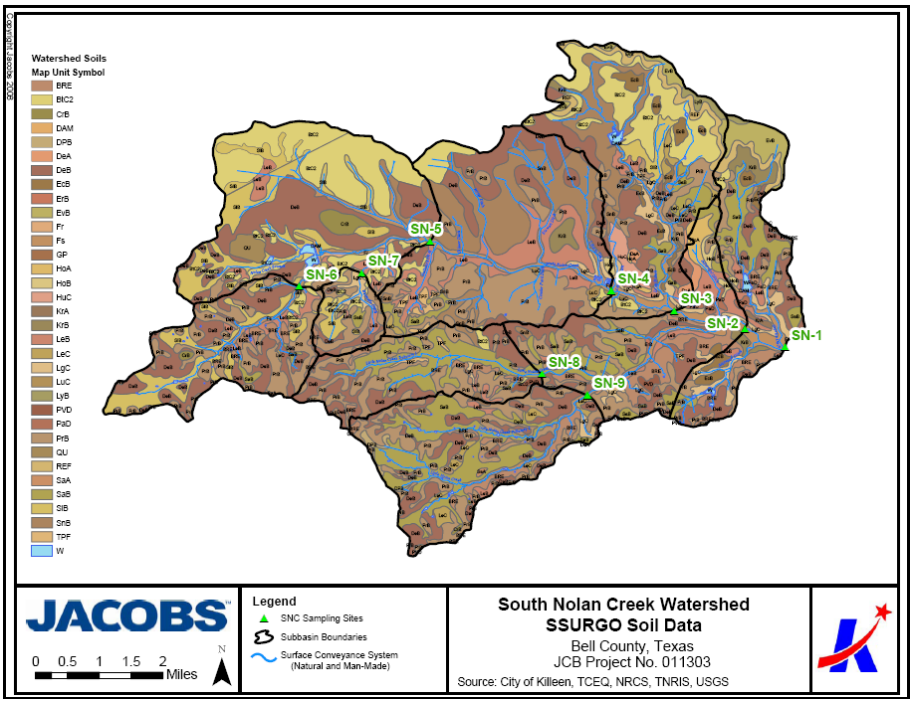

Figure 6. Distribution of Soils in the South Nolan Creek Watershed

An analysis of the soil types on which on site sewage facilities (OSSFs) are located indicated that in each case the soils had severe limitations for suitability of traditional adsorption fields (**Appendix B, Table B-1**). Factors affecting suitability included flooding, slow water movement, depth to bedrock and large stone content. This is one reason for the shift in the types of OSSFs installed in the area from traditional adsorption type systems to surface irrigation systems, which will be discussed further in Section 3.7.3 On-Site Sewage Facilities (OSSFs).

3.5 Land Use

The composition of land uses in the South Nolan Creek Watershed is shown in **Figure 7**. The City's zoning map was reclassified into traditional land use categories. The majority of the South Nolan Creek Watershed lies within the city limits and have assigned zoning. **Appendix B, Table B-2** lists the city zoning categories and the land use categories that were assigned.

The areas outside the city limits, generally in the upper portions of the sub-basins, are part of Fort Hood military base and were classified as developed and undeveloped areas based on aerial photography. The developed areas of the military base consist of military housing and operational buildings that are similar to other urban areas. Those areas that were classified as undeveloped are open areas devoid of buildings and other structures that are used for training or recreational areas. Military base land use categories are located in the upper portions of sub-basins SN-1, SN-3, SN-4 and SN-5.

The location of city parks and golf courses in the watershed were broken out as separate land use categories due to their potential as sources of nutrients and bacteria. Highly manicured golf courses and parks can be a source of elevated nutrients from commercial fertilizers. There are two

golf courses located in the watershed, one on Fort Hood (sub-basins SN-5 and SN-4) and one municipal golf course located in sub-basin SN-1. City parks are potential sources of bacteria due to higher concentrations of pet waste. There are 23 city parks distributed throughout the watershed. The largest concentration of parks are located in sub-basin 3 (81 acres), sub-basin 4 (138 acres), and sub-basin 9 (85 acres).

Medium density single family residential is the dominant land use category in the watershed followed by military base, transportation and commercial. The distribution of land uses differs for each sub-basin (**Figure 8**).

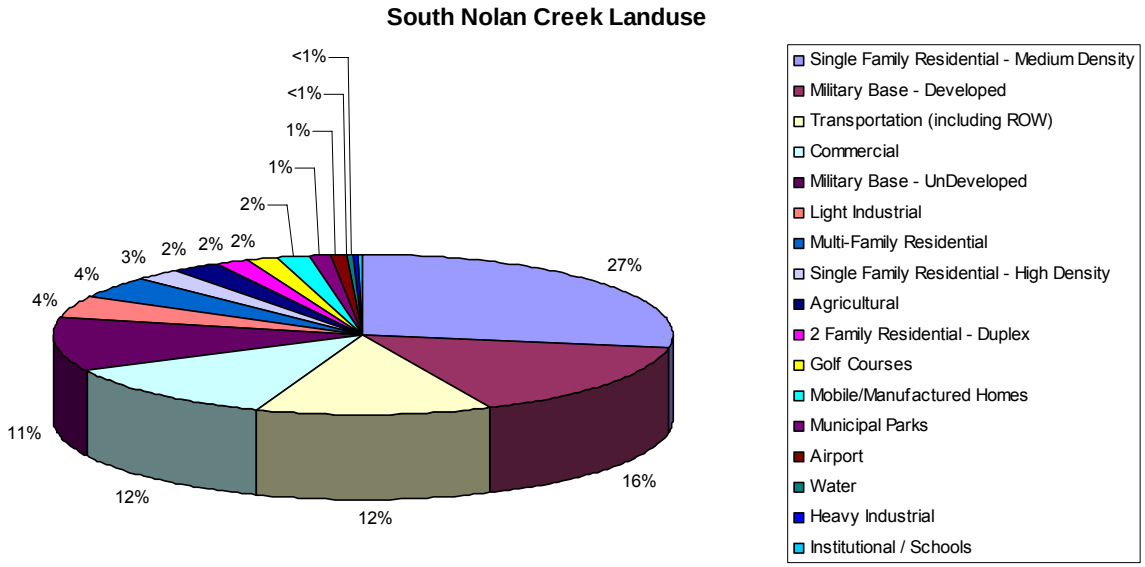

Figure 7. Composition of Land Uses in the South Nolan Creek Watershed

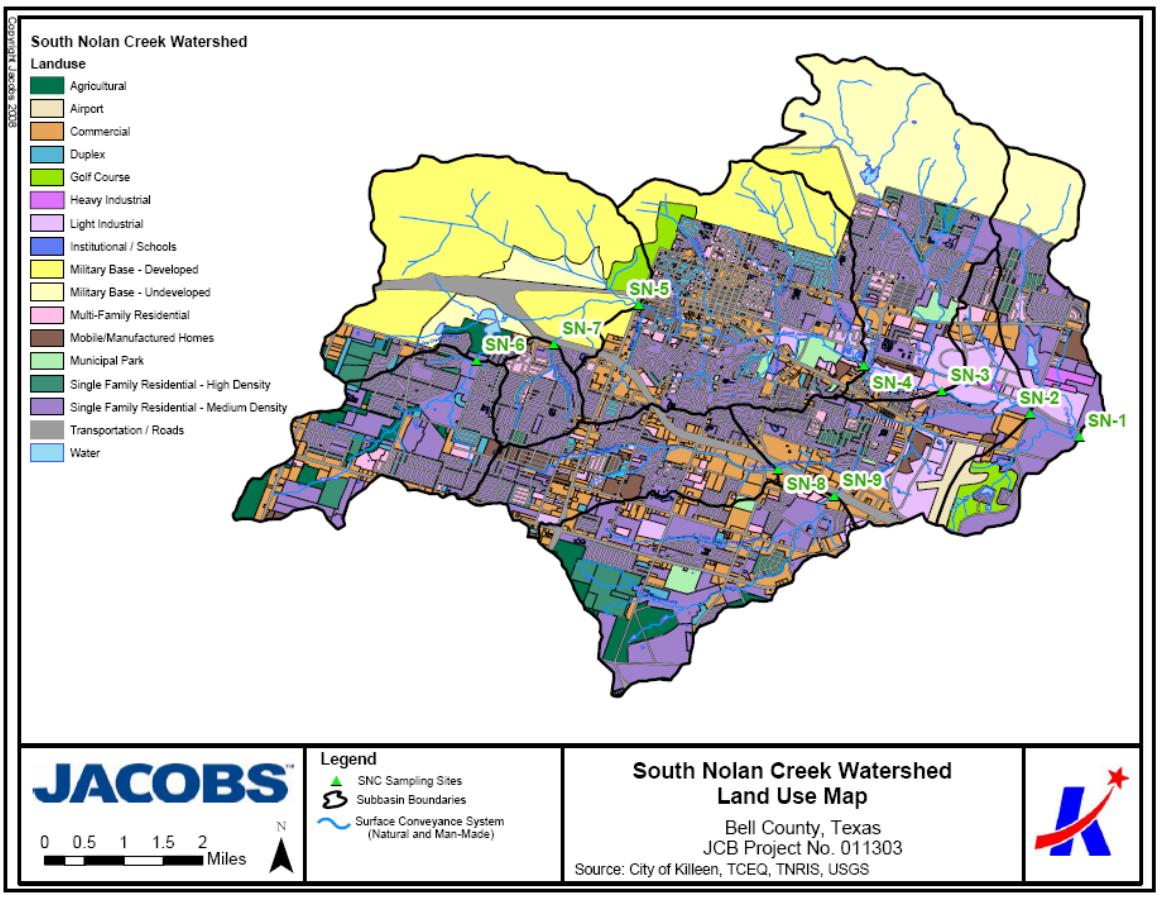

Figure 8. Distribution of Land Uses in the South Nolan Creek Watershed

3.6 Geology and Groundwater

The geology of the region consists of lower cretaceous limestone outcrops. The majority of the City is underlain by the Walnut Clay formation of the Fredericksburg Group that is comprised of clay, limestone and shale. This formation ranges in thickness from 125 to 175 feet. The north east portion of the City is located on geologic strata of the lower Washita Group and Edwards Limestone formation. A narrow band of the Comanche Peak Limestone formation outcrops between the strata of the Fredericksburg and Washita Groups.

Although the City of Killeen obtains its drinking water exclusively from Lake Belton, groundwater aquifers may be used as sources of drinking water in rural areas within Killeen's extraterritorial jurisdiction (ETJ). Groundwater may also serve as source water for irrigation of cropland. **Figure 9** depicts the major aquifers of Texas. The Trinity aquifer consists of early Cretaceous age formations of the Trinity Group extending through the central part of the state in all or parts of 55 counties, including Bell County. Formations comprising the Trinity Group are (from youngest to oldest) the Paluxy, Glen Rose, and Twin Mountains-Travis Peak.

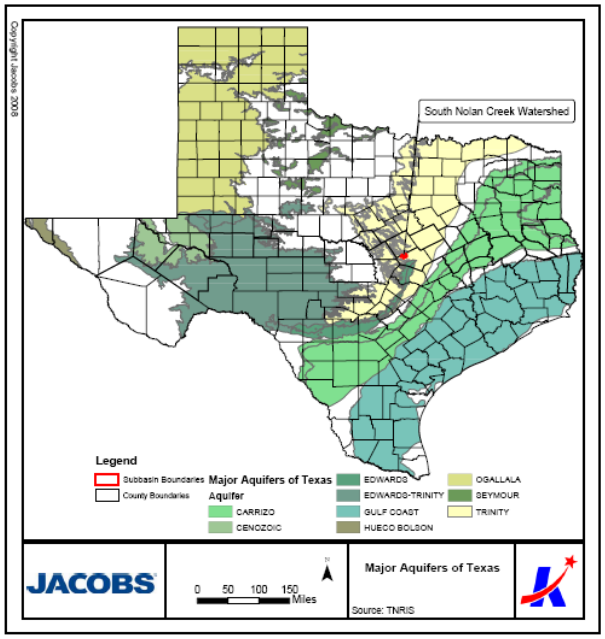

Figure 9. Major Aquifers of Texas

3.7 Potential Pollutant Sources

3.7.1 Urban Sources from Killeen's Municipal Separate Storm Sewer System

Several non-point sources of pollution are associated with urban areas. The most common urban pollutants include nutrients from fertilizers applied to lawns, parks and golf courses, bacteria from pet waste, and metals and oil/grease from roadways and parking lots. These pollutants may be washed into urban storm drain systems during storm events and are discharged to streams and lakes at outfalls from the municipal separate storm sewer system (MS4). In addition to event based transport to the storm sewers, there is the potential for dry weather discharges to the MS4 such as illicit discharges to the storm drain system, illegal connections of pipes plumbed to the storm sewer, and sanitary sewer overflows.

The State of Texas released the Texas Pollutant Discharge Elimination System (TPDES) general permit for regulation of Phase II Small MS4s on August 13, 2007. Phase I of TPDES MS4 permitting program affected larger municipalities with populations greater than 100,000. Phase II extended the MS4 regulations to smaller communities within urbanized areas as defined by the 2000 census. The City of Killeen is a regulated Phase II MS4 and was required to develop a Storm Water Management Program (SWMP) to reduce pollutants "to the maximum extent practicable". Elements of the City SWMP to reduce urban pollution are described in **Section 6.0**.

3.7.2 Sanitary Sewer Overflows

Sanitary sewer overflows (SSOs) have the potential to release untreated wastewater to the storm drain system. SSOs may be caused by blockages in the sewer pipes that prevent the wastewater from flowing to the treatment plant and leads to overflows. Another cause of SSOs is from inflow and infiltration of storm water into the sanitary sewer system. The influx of storm water can exceed

the capacity of sanitary sewer pipes and cause overflows.

The City tracks the occurrence of SSOs within the city limits. The City's SSO database records the date, location and estimated quantity of the overflow. This study examined the locations of SSOs that occurred during the monitoring period as a potential source of pollutants. The City documented 77 reported SSOs during the monitoring period. The locations of these SSOs are depicted in **Figure 10.**

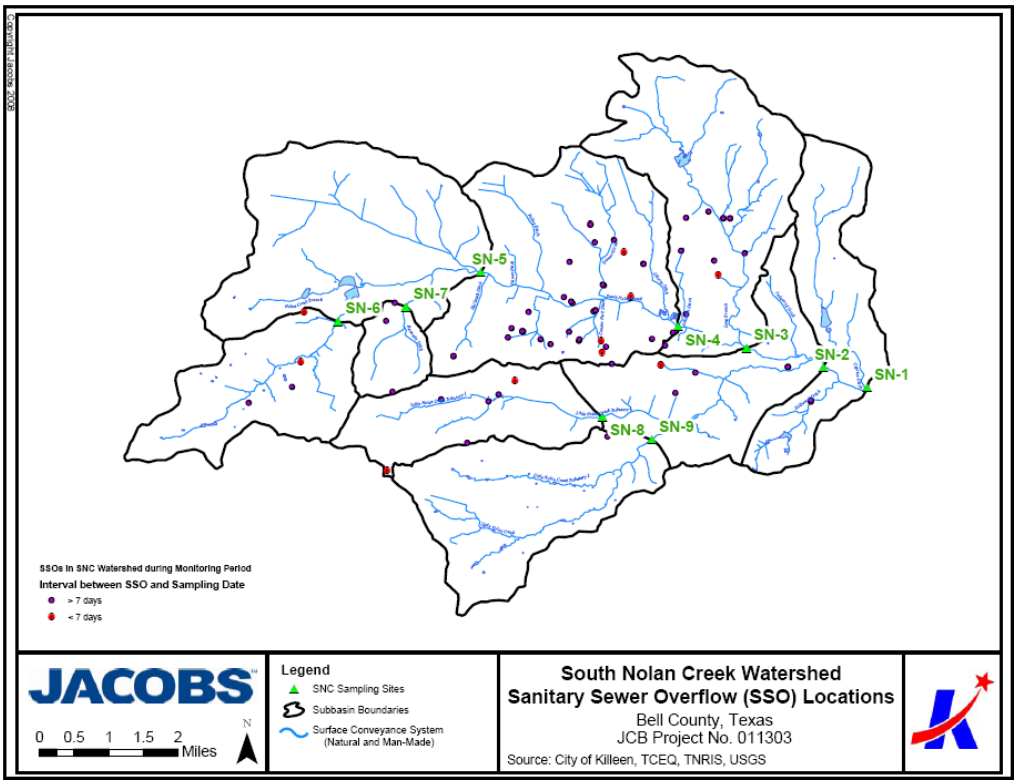

Figure 10. Location of Sanitary Sewer Overflows (SSOs) During the Monitoring Period

The timing of SSOs was examined to determine the effect SSOs may have had on the monitoring results. SSOs that occurred within 7 days prior to a monitoring date were examined. Of the 77 SSOs that occurred between October 2006 and February 2008, only 11 occurred within 7 days prior to sampling. The bacteria concentrations at upstream and downstream sampling sites were examined. The majority of the SSOs during the monitoring period occurred in sub-basin SN-4, which did not exhibit geometric mean bacteria concentrations in excess of the Texas Surface Water Quality Standards (discussed in Section 5.1.1). There were 2 SSO occurrences that coincided with elevated E. coli concentrations at downstream sampling sites but these were relatively minor overflows (<100 gallons) and at least 2 miles upstream of the sampling site. It is unlikely that the occurrence of SSOs contributed to the impairments that were observed during this study on the lower reach of the South Nolan Creek (discussed in Section 5.1.1).

The City plans to address SSOs as part of their Phase II Storm Water Management Program and will conduct an Inflow and Infiltration Study to determine specific causes of SSOs and locations for

infrastructure improvements (discussed in Section 6.3).

3.7.3 On-Site Sewage Facilities (OSSFs)

On-Site Sewage Facilities (OSSFs), commonly referred to as septic tanks, are a potential source of pollutants in the watershed. Improperly maintained or failing OSSFs can contribute bacteria and nutrients to surface and ground waters. The location and types of OSSFs in the watershed were determined based on records maintained by the City of Killeen and the Bell County Public Health District.

The City of Killeen maintains a database of OSSFs located within the city limits. When new areas are annexed by the City, residents in these areas become eligible for the City's Septic Tank Elimination Program. Through applications for the Septic Tank Elimination Program and data provided by the Bell County Public Health District, the City tracks the location of OSSF systems. OSSF addresses were geocoded in a mapping program and confirmed through ground truthing and inspection of aerial photography. The locations of OSSFs within the South Nolan Creek Watershed are depicted in **Figure 11**.

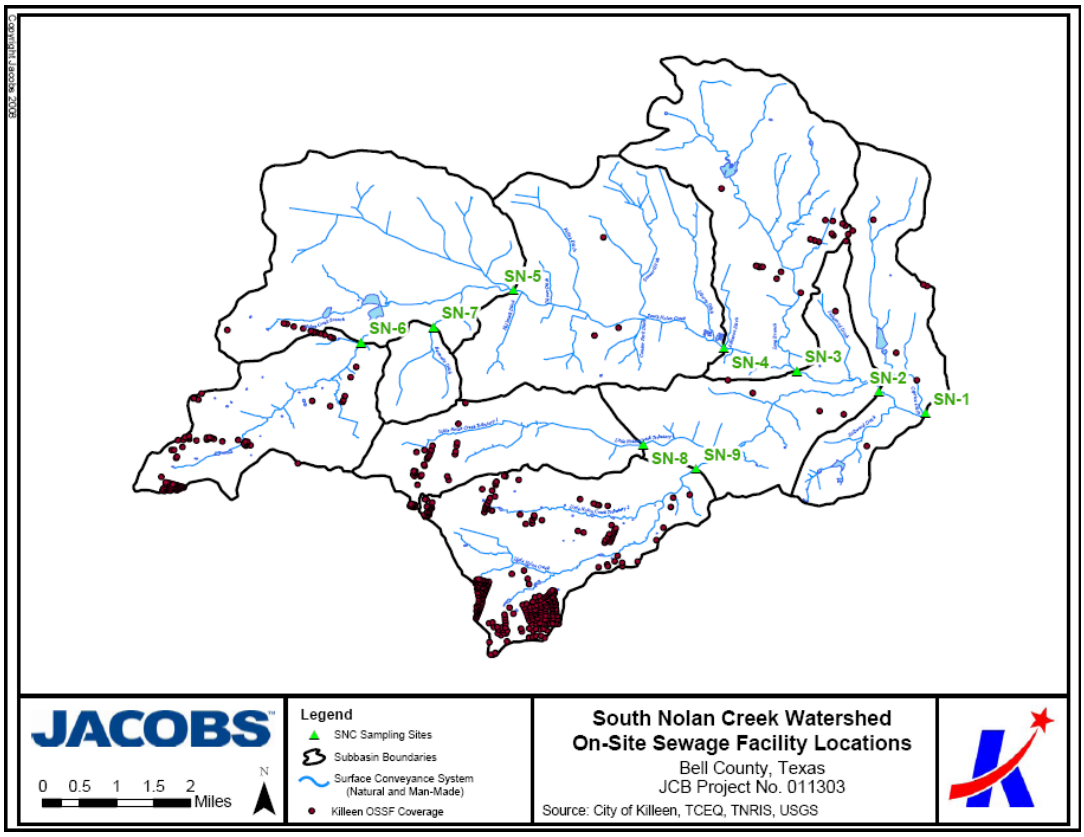

Figure 11. Distribution of OSSFs in South Nolan Creek Watershed

The distribution of OSSFs in the sub-basins is summarized in **Table 5**. With the exception of sub-basin SN-7, each sub-basin contains at least 1 OSSF. Table 5 lists the number of OSSFs within the sub-basins, the cumulative number above each sampling site and the density of systems. The

greatest number and highest density of OSSFs are located in sub-basin SN-9, which has 264 systems with a density of 8.56/100 acres. The second and third highest densities occur in sub-basins SN-6 and SN-8 with 106 and 37 OSSFs, respectively.

Table 5. Summary of OSSFs in Sub-Basins

Sub-Basin ID	# of OSSFs in Sub-Basin	Cumulative # of OSSFs Above Site	OSSF Density in Sub-Basin (#/100 Ac)
SN-1	8	451	0.33
SN-2	6	443	0.22
SN-3	18	136	0.43
SN-4	3	118	0.06
SN-5	9	115	0.20
SN-6	106	106	4.49
SN-7	0	0	0.00
SN-8	37	37	1.84
SN-9	264	264	8.56
Total	451		

The City's database documents the locations of OSSFs within the city limits but does not contain information regarding the age or type of the system. The Bell County Public Health District is the "authorized agent" designated by TCEQ to issue permits, investigate complaints, and enforce the requirements of the TCEQ's OSSF program. A query of the Bell County database for addresses within the City of Killeen was used to characterize the types of OSSFs in the area. The types of OSSFs in the Killeen area are summarized in **Table 6** and **Figure 12**. The two most common types of OSSFs located in the area are surface irrigation systems and traditional adsorption (leach fields). Over 50 percent of the OSSFs are surface irrigation systems. Twenty nine percent are the standard adsorption type systems with leach fields. The other OSSF types represent less than 10 percent of the total systems.

Table 6. Types of OSSFs with Killeen Address

OSSF Type	Percentage
Surface Irrigation	50.7%
Standard	29.0%
Drip Emitters	9.0%
Soil Substitution	4.0%
Low Pressure Dosing	3.9%
Evapotranspirative	2.1%
Leaching Chambers	0.6%
Unknown	0.4%
Holding Tank	0.2%
Secondary Treatment with Disinfection	0.1%

Source: Bell County Public Health District, 2008

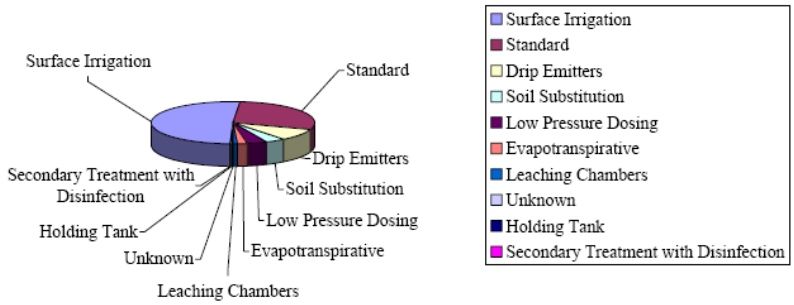

Figure 12. OSSF System Types with Killeen Address
Source: Bell County Public Health District, 2008

Each authorized agent in the State is required to submit a monthly report to the Texas On-site Wastewater Research Council that documents the number of systems permitted in their jurisdiction. The Bell County authorized agent monthly reports published by TCEQ were examined and summarized for the period of record (1995 – 2007). The data (**Figure 13**) clearly shows a shift in the types of OSSF systems from standard adsorption/leach field types of systems to surface irrigation systems. In the mid to late 1990s, the majority of systems installed in the county were conventional systems (**Figure 14**). From 1995 to 2007, surface irrigation systems (**Figure 15**) became more numerous and beginning in 2003 surface irrigation systems outnumbered traditional systems. Prior to 2007, the number of OSSFs installed each year in the county ranged between 543 and 868 with an average of 663 installed annually. The TCEQ data shows a sharp decline in the number of OSSFs installed in 2007 to 128 systems. It is unknown whether this is a true reflection of system installations or an anomaly in the data for 2007.

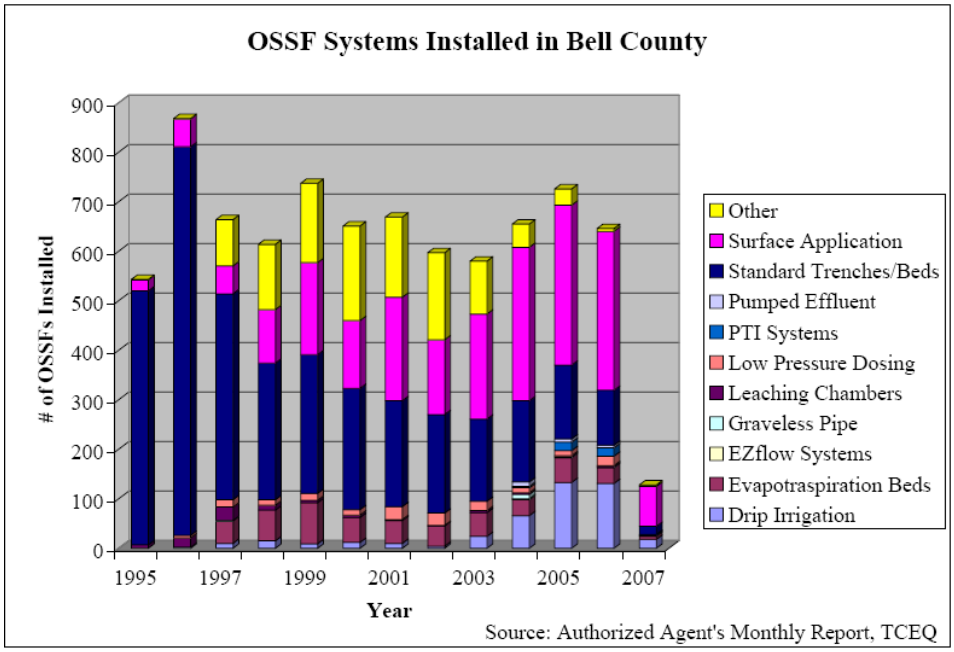

Figure 13. Types of OSSF Systems Installed in Bell County (1995 – 2007)

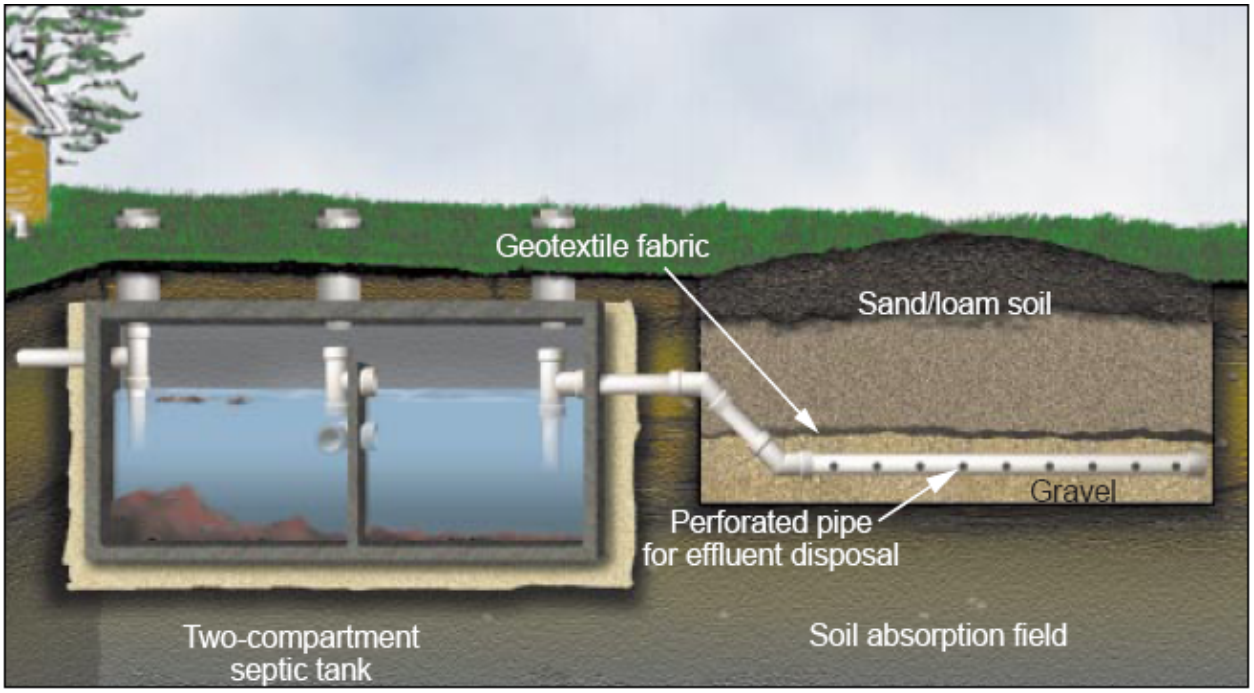

Figure 14. Conventional Septic Tank with Drain Field
(Source: Texas Agrilife Extension Factsheet (L-5234), Lesikar, 1999)

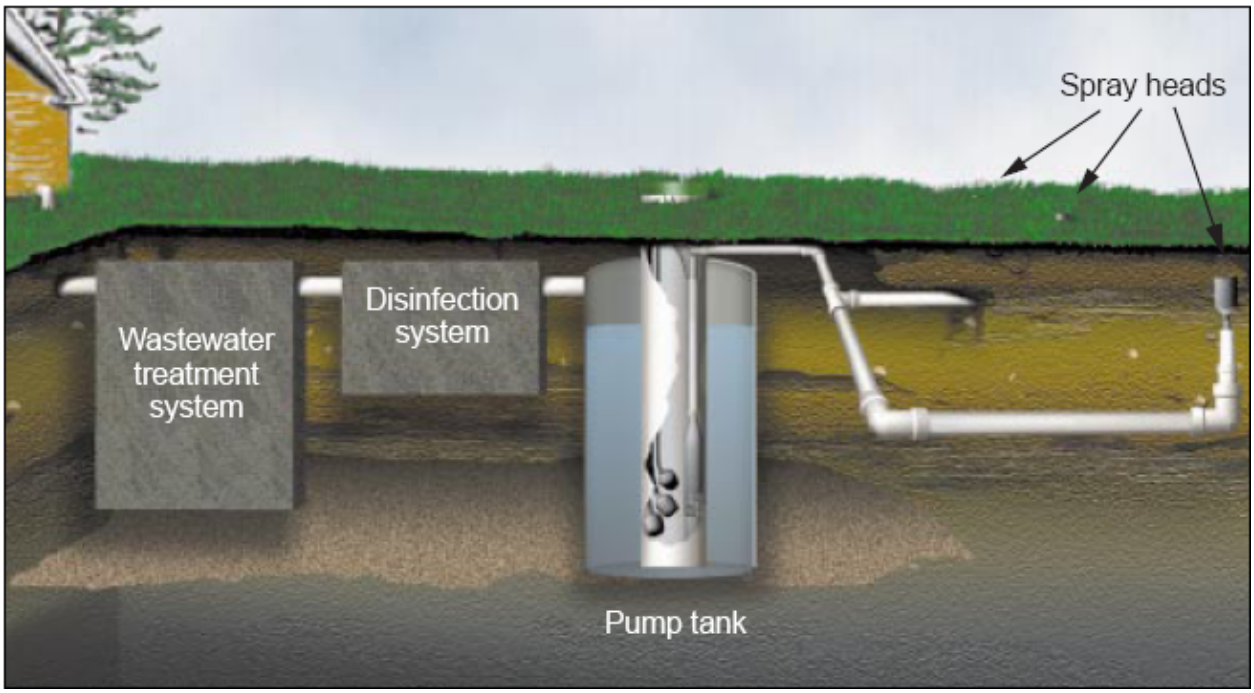

Figure 15. Surface Irrigation / Spray Distribution System
(Source: Texas Agrilife Extension Factsheet (L-5236), Lesikar, 1999)

3.7.4 Permitted Dischargers

There are three permitted dischargers and five outfalls located in the watershed (**Table 7** and **Figure 16**). The outfalls are located in sub-basins SN-5 and SN-4. Monthly discharge monitoring report (DMR) data were obtained from TCEQ for the monitoring period (October 2006 through February 2008).

Table 7. Permitted Dischargers and Outfalls

State Permit No.	Applicant	Outfalls	Sub-Basin
WQ0002233-000	U.S. Department of Army	2	SN-5
WQ0010351-002	Bell County WCID 1	1	SN-4
WQ0010351-003	Bell County WCID 1	1	SN-4
WQ0013358-001	Universal Services Fort Hood, Inc.	1	SN-5

There are 3 outfalls located in sub-basin SN-5. These outfalls are permitted for Fort Hood military base. Permit number WQ0013358-001 is issued to Universal Services Fort Hood, Inc. and authorizes the discharge of treated domestic wastewater at a daily average rate not to exceed 90,000 gallons per day. The permit was issued in 2004 and is scheduled to expire on May 1, 2009. The wastewater is treated through an activated sludge process plant operated in extended operation mode. Treatment units consist of a lift station, aeration basin, final clarifier, sludge digester and chlorine contact chamber. One outfall is permitted for this discharger. DMR data for this permit are located in (**Table B-3**. **Appendix B**), which contains information on dissolved oxygen, biochemical oxygen demand, pH, total suspended solids, flow and residual chlorine. Average monthly flows during the monitoring period ranged between 39,000 and 75,000 gallons per day and averaged 55,000 gallons per day. Based on flow data collected at sites SN-6 and SN-5 during ambient monitoring, it is estimated that the permitted discharge 13358-001 attributed less than 10 percent of the increase in flow between sites SN-6 and SN-5.

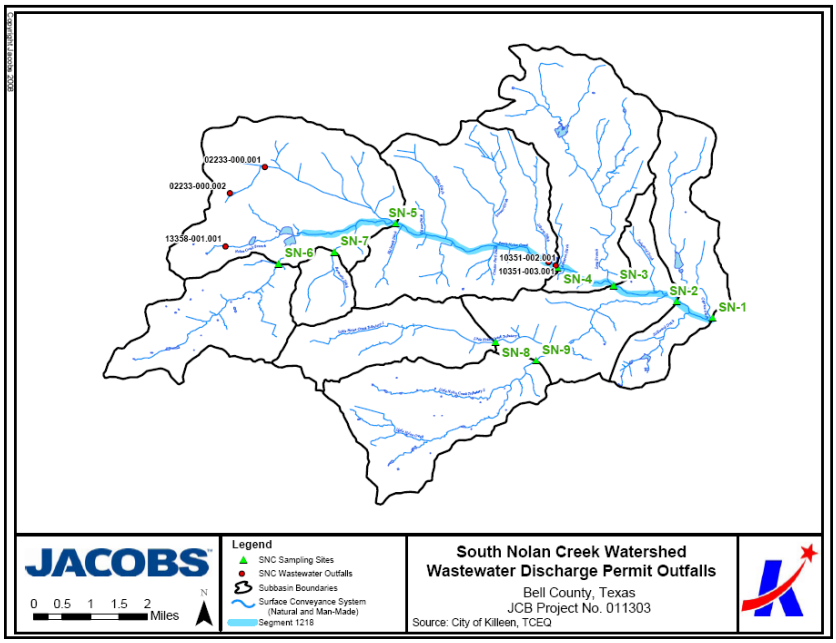

Figure 16. Permitted Wastewater Outfalls in the South Nolan Creek Watershed

Permit number WQ00002233-000 is issued to the U.S. Department of Army and consists of 2 outfalls, outfall 001 and outfall 002. The permit was issued on October 28, 2004 and expires on May 1, 2009. The outfalls are for the discharge of treated wastes from vehicle cleaning. Wastewater from the wash-racks occurs intermittently only when vehicles are being cleaned. Outfalls 001 and 002 consist of wash rack wastewater that is collected in a trough and discharged to a baffled tank. Solids settle by gravity and oil floats to the surface. The accumulated oil is skimmed off the top and the wastewater is discharge to an oil/sand separator. These outfalls have effluent limits for Chemical Oxygen Demand (daily maximum = 200 mg/L), Total Suspended Solids (daily maximum = 30 mg/L), Oil and Grease (daily maximum = 15 mg/L) and pH (minimum of 6.0 and maximum of 9.0). The TCEQ DMR data for this permit is presented in **Table B-4** of **Appendix B**. No discharge was reported at either outfall during the monitoring period (October 2006 – February 2008).

The Bell County Water Control and Improvement District No. 1 holds 2 discharge permits with outfalls to the South Nolan Creek in sub-basin SN-4. Permit WQ0010351-002 was issued on April 6, 2004 and is scheduled to expire on April 1, 2009. This permit is for the discharge of up to 18 million gallons per day (MGD) of treated domestic wastewater from the Treatment Facility. Effluent limitations that are specified in the permit are listed in **Table 8**.

Table 8. Effluent Limitations for Bell County Water Control and Improvement District No. 1 Permit WQ0010351-002 and WQ0010351-003

Parameter	7-Day Average	Daily Max	Single Grab
Chemical Oxygen Demand	15 mg/L	25 mg/L	35 mg/L
Total Suspended Solids	25 mg/L	40 mg/L	60 mg/L
Ammonia Nitrogen	5 mg/L	7 mg/L	13 mg/L

pH limits between 6.0 and 9.0
DO minimum of 6.0 mg/L

The TCEQ DMR data for this permit are presented in **Table B-5** of **Appendix B**. During the monitoring period the average monthly discharge was 10.41 MGD and ranged between a low of 8.15 MGD to a high of 16.02 MGD.

A second permit (WQ0010351-003) was issued to Bell County Water Control and Improvement District No. 1 for discharge from Plant No. 2 Wastewater Treatment Facility. This permit was issued on August 26, 2004 and expires on May 1, 2009 for the discharge of up to 6 MGD of treated domestic wastewater. The same effluent limitations (**Table 8**) apply to this permit. The TCEQ DMR data for this permit are presented in **Table B-6** of **Appendix B**. During the monitoring period the average monthly discharge was 3.32 MGD and ranged between a low of 1.31 MGD to a high of 6.45 MGD.

By examining the combined monthly mean discharge from the Bell County Water Control and Improvement District No. 1 Wastewater Treatment Plant outfalls, and the flow measurements that were taken during ambient monitoring, it was estimated that the treatment plant discharges contribute to between 68 and 92 percent of the flow increase between sites SN-5 and SN-4.

4.0 Sampling Plan

The sampling plan for the South Nolan Creek was designed to address surface water quality impairments and concerns that were noted by the TCEQ. The primary focus was on bacteria since the Segment is listed on the 303(d) List for impairment of the contact recreation use. Therefore, bacteria concentrations were monitored more frequently than the other water quality parameters. In addition to the ambient monitoring for bacteria, the City chose to monitor nutrients and other pollutants that are typically associated with urban sources including nutrients, biochemical oxygen demand, metals, total suspended solids, oil/grease and physical properties such as water temperature, pH, dissolved oxygen, and specific conductance. The monitoring program included both ambient and wet-weather sampling. Specifics of the sampling are discussed below. The water quality monitoring parameters, methods, units of measure and monitoring frequency are listed in **Appendix C Table C-1.**

Results of routine and wet-weather monitoring were used to identify priority areas in the City for on-site sewage facility (OSSF) inspections, sewer conversions through the City's Septic Tank Elimination Program, targeted public education programs and dry weather screening. These programs are discussed in **Section 6.0**.

4.1 Sampling Sites

Nine sampling sites were selected for monitoring as part of this assessment. The locations of the sampling sites are shown in **Figure 1**. Six of the nine sites are located on the South Nolan Creek to determine longitudinal changes in water quality along the main stem of the creek. The furthest upstream site (Site SN-6) is upstream of the beginning of Segment 1218. Sites SN-5, SN-4, SN-3, SN-2, and SN-1 (listed in upstream to downstream order) are located on Segment 1218. Site SN-7, SN-8, and SN-9 are located on major tributaries to the South Nolan Creek. Descriptions of the sampling sites are listed in **Table 9**. Full descriptions including the latitudes and longitudes are included in **Appendix C, Table C-2**. Each site is denoted by a City specific site ID. These sites also have a TCEQ assigned Site ID number as specified in **Table 9**. Killeen's site designations rather than the TCEQ site numbers are used throughout this report to identify the sampling sites.

Table 9. Monitoring Site Locations

TCEQ Site ID	Killeen Site ID	Description
18826	SN-1	South Nolan Creek at Ann Boulevard
11913	SN-2	South Nolan Creek at Roy Reynolds Drive
18827	SN-3	South Nolan Creek at Twin Creek Drive
18828	SN-4	South Nolan Creek at 38th Street
15271	SN-5	South Nolan Creek at SH 195
18829	SN-6	South Nolan Creek at Watercrest Road
18830	SN-7	Bermuda Ditch at Central Texas Expressway
18833	SN-8	Little Nolan Creek Tributary at Central Texas Expressway
18834	SN-9	Little Nolan Creek at Central Texas Expressway

4.2 Sub-Basins

The South Nolan Creek Watershed within the Killeen city limits was delineated based on the United States Geological Survey (USGS) Digital Elevation Model (DEM) data. The South Nolan Creek Watershed encompasses 26,589 acres and was divided into 9 smaller sub-basins that represent the drainage area immediately above each sampling site (**Figure 1**) that are not characterized by an upstream sampling site. The sub-basins are denoted based on the sampling site that is located immediately downstream. For example, the SN-4 sub-basin is the sub-basin located upstream of site SN-4. The total watershed affecting downstream sampling sites on the South Nolan Creek include all upstream sub-basins. For example, water quality at site SN-4 includes all upstream sub-basins so the total watershed influence at site SN-4 is from sub-basins SN-4, SN-5, SN-6 and SN-7. The sub-basin influence for each of the sampling sites is listed in **Table 10**.

Table 10. Sub-Basin Influence at Sampling Sites

Sampling Site	Sub-Basins Influencing Water Quality
SN-1	SN-1, SN-2, SN-3, SN-4, SN-5, SN-6, SN-7, SN-8, SN-9
SN-2	SN-2, SN-3, SN-4, SN-5, SN-6, SN-7, SN-8, SN-9
SN-3	SN-3, SN-4, SN-5, SN-6, SN-7
SN-4	SN-4, SN-5, SN-6, SN-7
SN-5	SN-5, SN-6, SN-7
SN-6	SN-6
SN-7	SN-7
SN-8	SN-8
SN-9	SN-9

4.3 Ambient Monitoring

Ambient monitoring was conducted at two different frequencies and is discussed below.

4.3.1 Monthly Monitoring

Bacteria monitoring was conducted on a monthly basis from October 2006 through February 2008 at nine sites and included six sites on the South Nolan Creek and three tributary sites. Fourteen monthly samples were collected during the 17 month monitoring period. February and March 2007 sampling dates were missed due to personnel changes at the City. The May 2007 sampling date was missed due to widespread flooding in the watershed (**Figure 17**).

Figure 17. Flooding at Site SN-6

4.3.2 Semi-Annual Monitoring

Ambient monitoring was conducted semi-annually (twice per year) at five main stem stream sites (SN-2, SN-3, SN-4, SN-5 and SN-6) on the South Nolan Creek. Monitoring parameters included nutrients, biochemical oxygen demand, metals, total suspended solids and physical properties such as water temperature, pH, dissolved oxygen, and specific conductance. Ambient monitoring was conducted on January 11, 2007, July 18, 2007 and January 9, 2008.

4.4 Wet Weather Monitoring

Wet-weather monitoring was conducted at a single site where the South Nolan Creek leaves the City of Killeen and enters the City of Harker Heights (Site SN-2) to characterize pollutant Event Mean Concentrations (EMCs) leaving the City. Nine storm events were monitored during the

study. Automated sampling and flow measurement equipment was installed at Site SN-2 to capture storm event samples (**Figure 18**). Sequential samples were taken upon initiation of the sampler based on a rise in water level and at predetermined intervals thereafter. Flow weighted composite samples were prepared in the TIAER laboratory based on flow data recorded by the bubbler-type flow meter. Rating curves were developed for the site based on measurements collected by the City and TIAER.

Figure 18. Automated Sampler for Wet-Weather Monitoring at Site SN-2

5.0 Water Quality Monitoring Results

Graphs and tables of water quality monitoring results are presented in **Appendix C** for monthly bacteria monitoring, **Appendix D** for semi-annual ambient monitoring, **Appendix E** for wet-weather monitoring and **Appendix F** for ambient and wet-weather metals monitoring. Selected tables and graphs are presented in the report body to support the findings, as appropriate.

5.1 Ambient Monitoring

5.1.1 Bacteria

The results of the monthly bacteria monitoring are shown in **Figures C-1** through **C-5** in **Appendix C**. The number of samples, geometric mean, number of exceedances of the TSWQS and the percentage of exceedances are listed in **Table 11**. As shown in **Figure 19,** geometric means at the main stem South Nolan Creek sites are well below the TSWQS criteria of 126 MPN/100 mL at upstream sites SN-6, SN-5 and SN-4. Geometric mean concentrations in excess of the TSWQS criteria were observed at the lower watershed sites SN-3, SN-2 and SN-1. The greatest number of exceedances (43% of samples) were observed at Site SN-2 due to the combined influences of Long Branch (sub-basin SN-3) and Little Nolan Creek (sub-basins SN-8 and SN-9) as shown in **Figure 20**. SN-2 also had the highest E. coli geometric mean concentration of 330 MPN/100mL. Site SN-3 below the Long Branch confluence and SN-9 on Little Nolan Creek each had 4 exceedances of the TSWQS (29% exceeding criterion). Site SN-7, which was usually dry during ambient monitoring had 3 of the 5 samples (60%) collected that exceeded the criteria. Individual sample results are shown in **Figure C-3**, 26 of the 117 samples collected during this study exceeded the single sample criterion of 394 MPN/100mL.

Table 11. Results of Monthly Bacteria Monitoring

Site	Geometric Mean[1] (MPN/100 mL)	# of samples	# of exceedances	% Exceeding Criterion
SN-1	230	14	2	14.3%
SN-2	330	14	6	42.9%
SN-3	180	14	4	28.6%
SN-4	29	14	1	7.1%
SN-5	52	14	1	7.1%
SN-6	60	14	2	14.3%
SN-7	--[2]	5	3	60.0%
SN-8	156	14	3	21.4%
SN-9	164	14	4	28.6%
	Totals	**117**	**26**	

[1] Rounded to 2 significant digits

[2] Geometric mean not computed due to small sample size

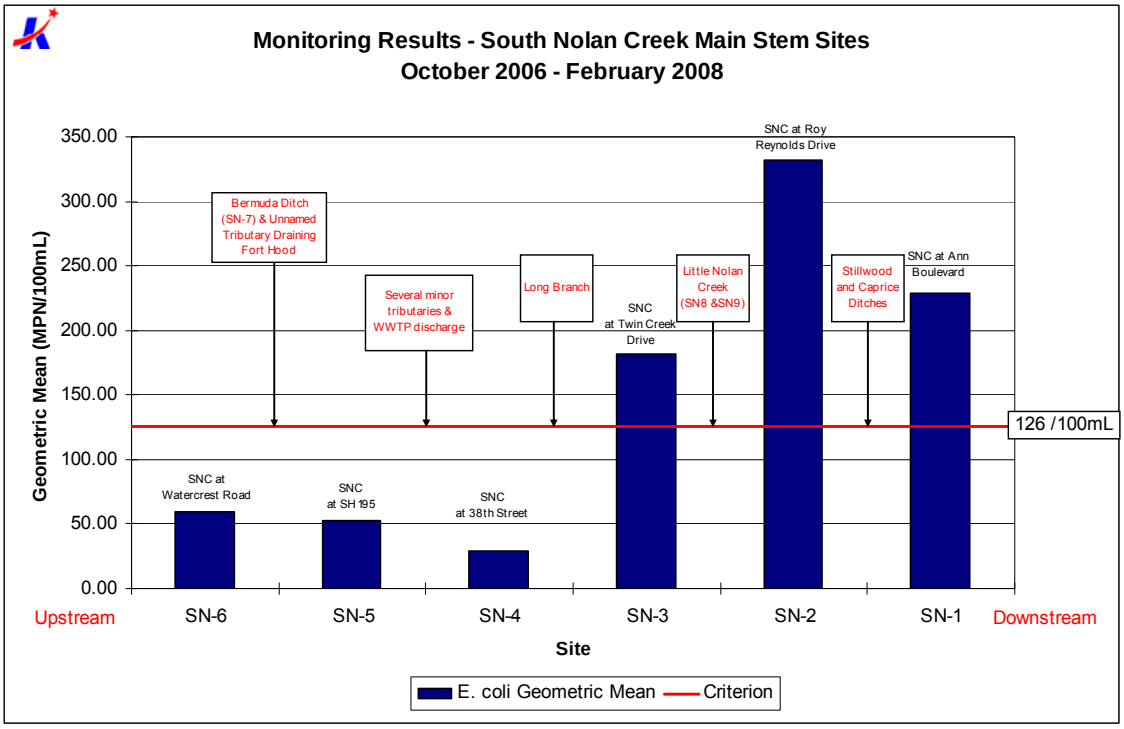

Figure 19. Geometric Mean E. coli Concentrations at Main Stem South Nolan Creek Sites

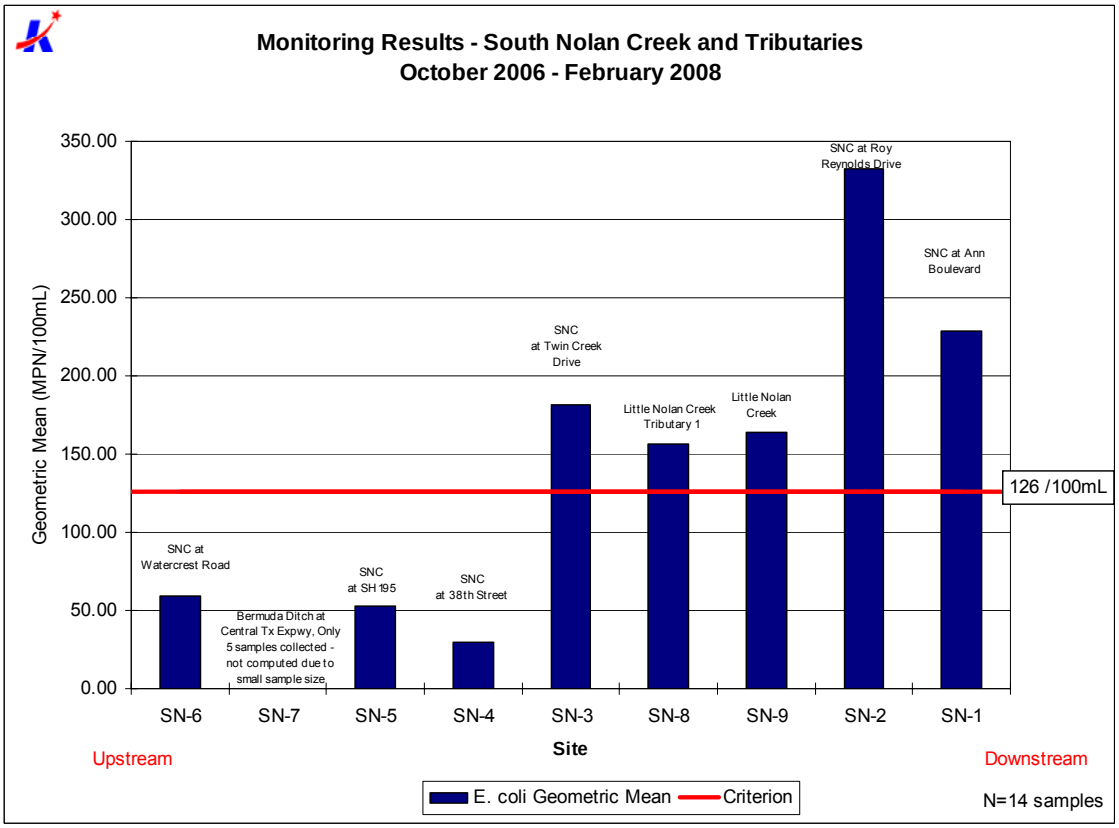

Figure 20. Geometric Mean E. coli Concentrations in the South Nolan Creek Watershed

5.1.2 Flow

The instantaneous flows measured during the semi-annual ambient monitoring are shown in **Figure 21.** Flow at the upstream site (SN-6) was less than 3 cubic feet per second (cfs). Flows gradually increased at site SN-5 due to the increase in the size of the watershed and point source permitted discharges in sub-basin SN-5. A dramatic increase in flow is apparent between site SN-5 and SN-4 due to the permitted discharge from the Bell County WCID Wastewater Treatment Plant. Steady flows or slight decreases in flows were observed downstream of the treatment plant outfalls.

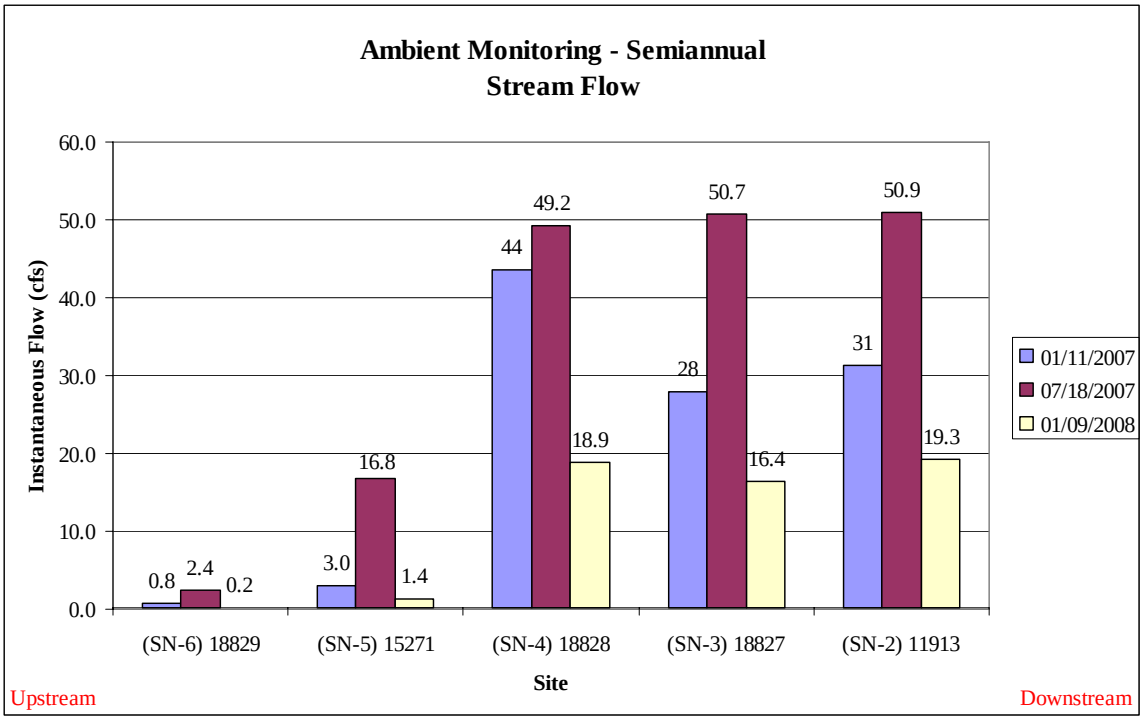

Figure 21. Ambient Monitoring Results - Flow

5.1.3 Nutrients

The results of ambient monitoring for nutrients are shown in **Appendix D**, **Figures D-2** through **D-6.** The concentrations of nutrients were compared to the TCEQ screening levels. Sites upstream of the WWTP outfalls (Sites SN-6 and SN-5) exhibited nutrient concentrations below TCEQ screening levels; however, sites below the WWTP outfalls (Sites SN-4, SN-3 and SN-2) exhibited concentrations above the TCEQ screening levels. A marked increase in ammonia, nitrate plus nitrite, total Kjeldahl nitrogen, orthophosphate and total phosphorus concentrations were observed between Site SN-5 (above the WWTP outfalls) and Site SN-4 (below the WWTP outfalls). The highest concentrations were generally observed at Sites SN-4 and SN-3 during the winter months. Nutrient concentration during the winter months were three to six times greater than the screening levels at sites below the WWTP outfalls as can be seen in **Figure 22** and **Figure 23**.

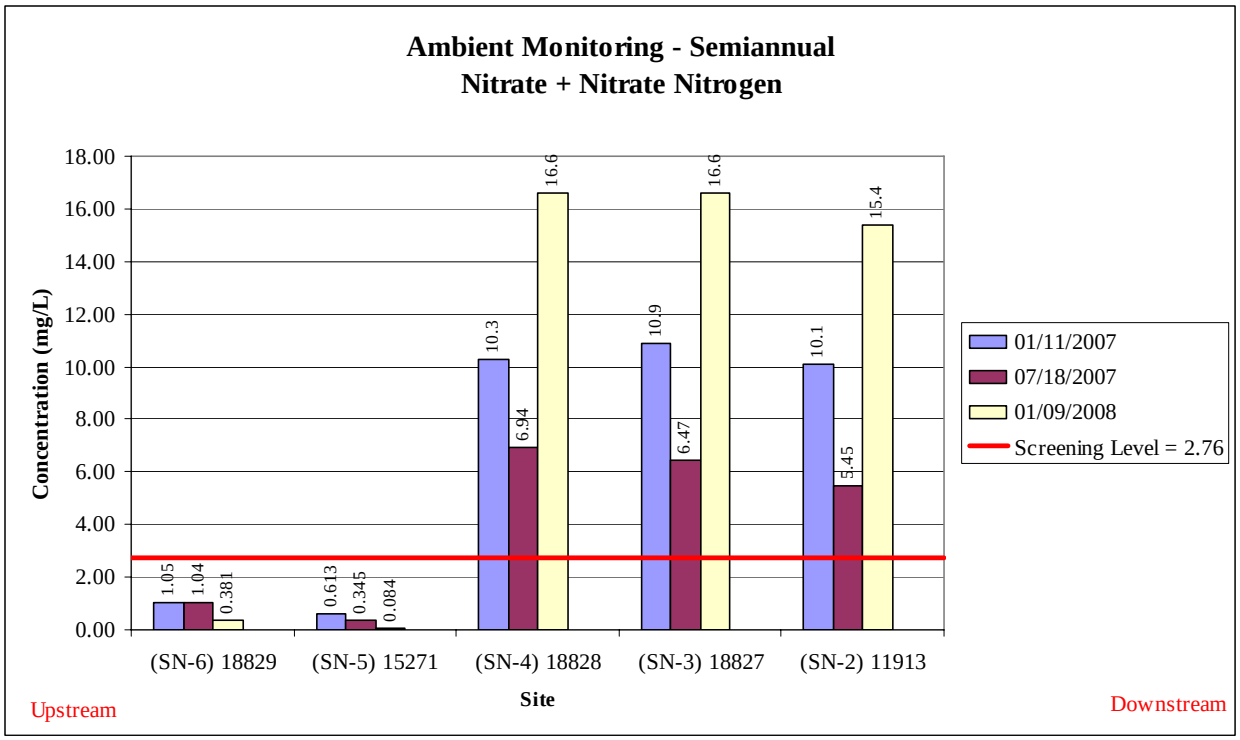

Figure 22. Ambient Monitoring Results – Nitrate + Nitrite Nitrogen

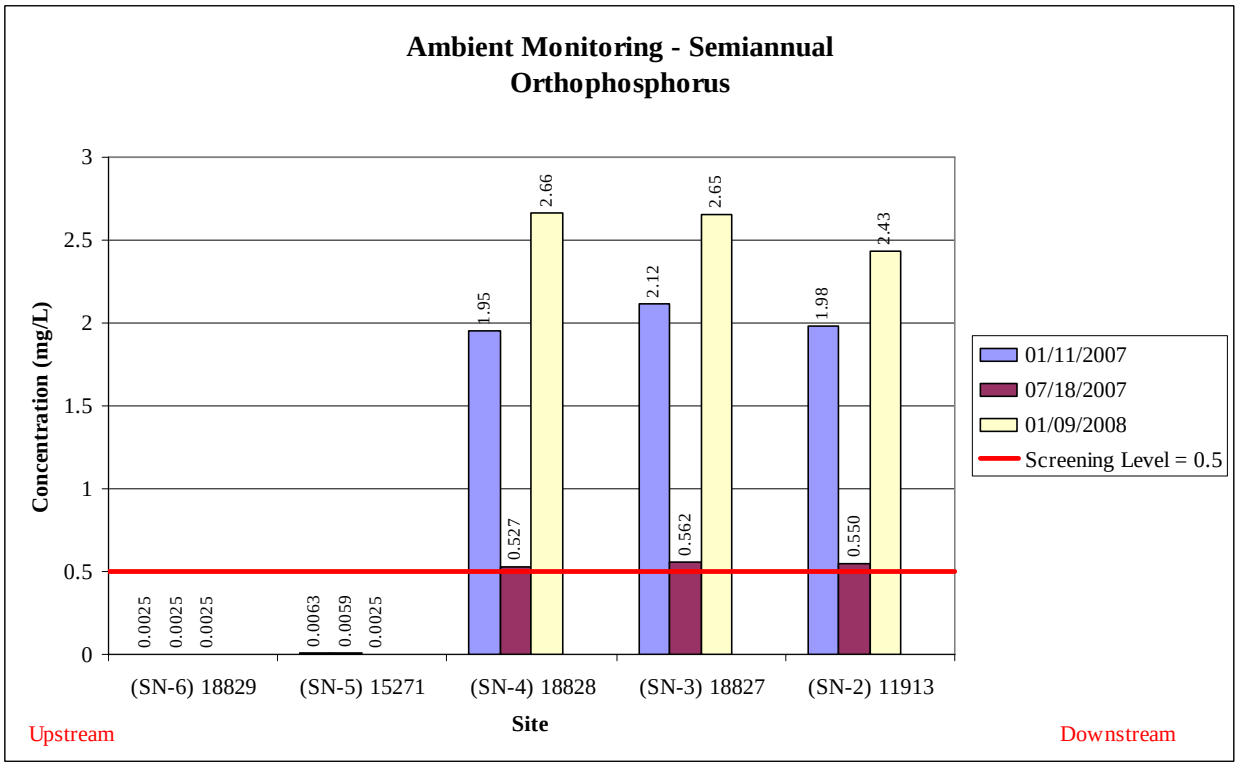

Figure 23. Ambient Monitoring Results – Orthophosphate Phosphorus

5.1.4 Sediment

The ambient monitoring results for total suspended solids (TSS) were below the Limits of Quantitation (LOQ) for the test (< 4 mg/L) for all samples except for one sample that had a TSS concentration of 11 mg/L. Sediment concentrations during low flow ambient conditions do not appear to be a problem in the watershed.

5.1.5 Dissolved Oxygen/Oxygen Demand

Dissolved oxygen (DO) concentrations that were measured in-situ during ambient monitoring are shown in **Appendix D**, **Figure D-8**. DO concentrations ranged between 7.7 and 11.7 mg/L and were well above the TSWQS criterion of 5.0 mg/L for Segment 1218.

Biochemical oxygen demand-5 day (BOD5) measurements were all below the LOQ for the test (<2 mg/L).

5.1.6 In-Situ Measurements (pH, Conductivity and Temperature)

Ambient monitoring results for in-situ measurements of pH, specific conductance and water temperature are shown in **Appendix D**, **Figures D-9**, **D-10** and **D-7**, respectively. All the measurements were within allowable limits set by the TSWQS. The influence of the WWTP discharges is evident during the winter months by the increase in water temperatures of 6 to 7 degrees at Site SN-4 when compared to the upstream site, SN-5.

5.1.7 Oil and Grease

Oil and grease samples collected during ambient monitoring were all below the LOQ for the test (<5 mg/L).

5.1.8 Metals

The results of ambient monitoring for metals are listed in **Appendix F**, **Table F-1.** The following metals were analyzed.

- Arsenic (Dissolved)
- Barium (Dissolved)
- Cadmium (Dissolved)
- Chromium (Total)
- Copper (Dissolved)
- Lead (Dissolved)
- Manganese (Total)
- Nickel (Dissolved)
- Selenium (Total)
- Silver (Dissolved)
- Zinc (Dissolved)

Description statistics (minimum, maximum, and mean concentrations) are listed in **Table F-2.** With the exception of dissolved Barium and total Manganese, most metals concentrations were below the LOQ for the tests. As shown in **Table F-2**, none of the metals concentrations exceeded the aquatic life or human health criteria that were computed for Segment 1218. The aquatic life chronic

and acute criteria were computed based on a Hardness of 160 and a Water Effects Ratio of 1 as specified for Segment 1218 (TCEQ, 2003).

5.2 Wet Weather Monitoring

Results of the wet-weather monitoring that was conducted at site SN-2 are presented in **Appendix E**, **Figures E-1** through **E-12**. Nine storm events were monitored (**Table 12**). Event mean concentrations (EMCs) were calculated for each of the parameters based on the flow-weighted concentrations observed during the nine storm events. The storm events represented a broad range of different sized events with durations between 7 and 28 hours and average flows ranging from 29 cfs to 100 cfs. Although the TSWQS do not apply under wet-weather conditions, a comparison of the mean EMCs to TCEQ screening levels indicated that the mean nutrient EMCs were below the TCEQ screening levels (**Figure 24**).

Table 12. Storm Events Monitored at Site SN-2

Killeen Site ID	TCEQ Site ID	Storm Event	Start Date	Start Time	End Date	End Time	Duration (hrs)	Number of Samples	Average Flow (cfs)
SN-2	11913	1	10/10/2006	07:23	10/11/2006	05:23	22.0	14	28.59
SN-2	11913	2	10/16/2006	07:40	10/17/2006	08:08	24.5	15	51.85
SN-2	11913	3	04/17/2007	19:20	04/18/2007	10:45	15.4	10	38.90
SN-2	11913	4	04/30/2007	06:25	05/01/2007	05:50	23.4	14	40.75
SN-2	11913	5	05/01/2007	05:55	05/02/2007	10:00	28.1	14	100.52
SN-2	11913	6	06/14/2007	07:20	06/14/2007	14:45	7.4	6	56.08
SN-2	11913	7	06/14/2007	14:50	06/15/2007	09:40	18.8	7	53.72
SN-2	11913	8	09/04/2007	18:00	09/05/2007	15:25	21.4	13	50.73
SN-2	11913	9	12/15/2007	03:35	12/15/2007	13:40	10.1	7	29.32

5.2.1 Event Mean Concentrations (EMCs)

EMCs were computed based on flow-weighted samples collected during wet-weather monitoring (**Table 13**).

Table 13. Descriptive Statistics for Wet-Weather Monitoring Results

	Flow Weighted Concentrations (Event Mean Concentrations)							Instantaneous Conc.
Descriptive Statistic	TSS	BOD-5	Ammonia-N	Nitrate+ Nitrite-N	Total Kjeldahl-N	Total Phosphorus	Orthophosphorus	Oil & Grease
	00530	00310	00608	00631	00625	00665	70507	00552
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Min of EMCs	115	5.10	0.010	1.00	0.21	0.43	0.122	2.5
Max of EMCs	750	13.70	0.211	3.10	1.68	0.68	0.415	25.4
Mean of EMCs	287	8.53	0.063	1.94	1.24	0.55	0.282	7.0
Median of EMCs	200	8.1	0.04	1.74	1.41	0.56	0.296	2.5

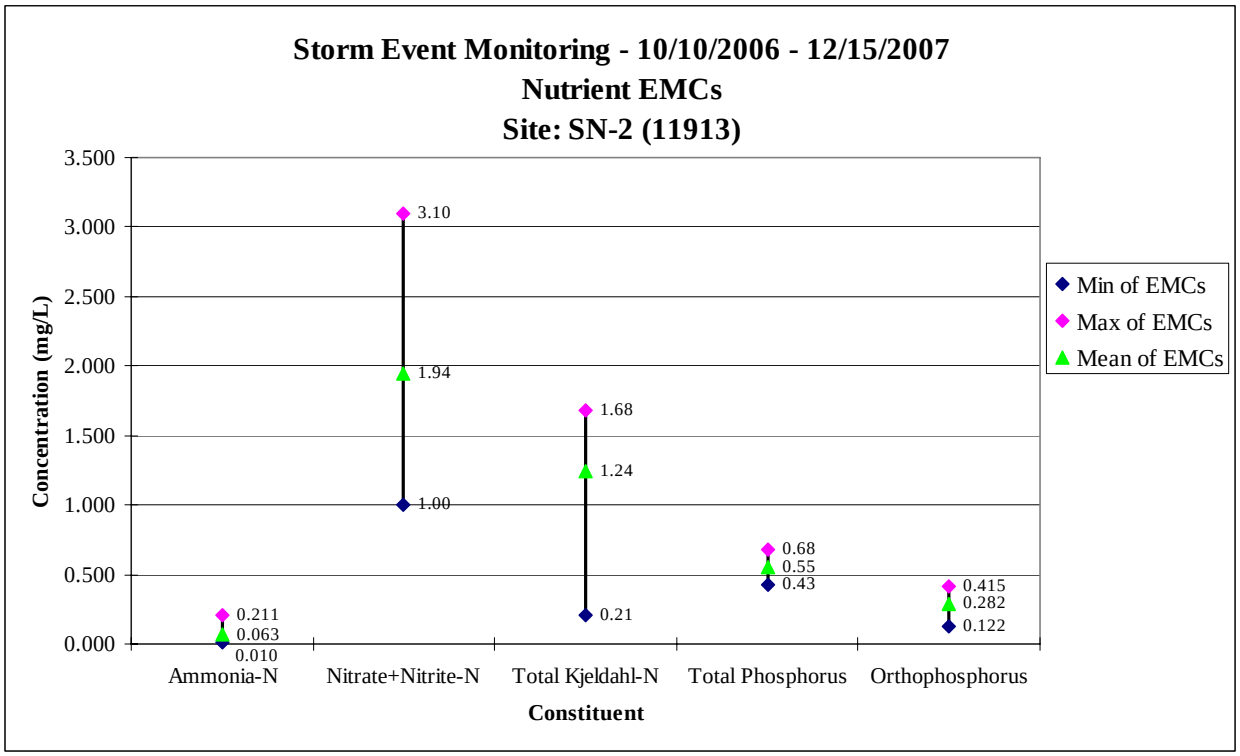

Figure 24. Event Mean Nutrient Concentrations Computed Based on Wet-Weather Monitoring

6.0 City Programs / Best Management Practices

The City of Killeen developed a Storm Water Management Program (SWMP) to meet State and Federal regulatory requirements for Phase II Municipal Separate Storm Sewer Systems (MS4s). TCEQ released the final Phase II MS4 General Permit on August 13, 2007 and required regulated MS4s to develop and submit their Notice of Intent (NOI) and SWMP to the state on or before February 11, 2008 to be covered under the General Permit. The City submitted its NOI and SWMP to the TCEQ on February 1, 2008. TCEQ has completed the administrative and technical review of Killeen's SWMP and following a 30-day public comment period, the City's MS4 will be covered under TPDES General Permit TXR040000.

Phase II MS4 regulations require the City of Killeen to "develop, implement, and enforce a storm water program to reduce the discharge of pollutants to the Maximum Extent Practicable, to protect water quality, and satisfy the appropriate water quality requirements of the Clean Water Act." The City's SWMP includes 37 Best Management Practices (BMPs) grouped into 6 minimum control measures that are required for permit coverage.

- Public Education and Outreach for Storm Water Impacts
- Public Involvement/ Participation
- Illicit Discharge Detection and Elimination
- Construction Site Storm Water Runoff Control
- Post-Construction Storm Water Management in New Development and Redevelopment
- Pollution Prevention/Good Housekeeping for Municipal Operations

The City is currently implementing the 37 BMPs identified in the SWMP. Some of the BMPs are ongoing City programs that have been in place for several years while others are new BMPs that will be implemented within the next 4 years. The BMPs must be fully implemented within the 5-year permit term, which ends on August 12, 2012.

While all the SWMP BMPs will reduce storm water pollutants and improve water quality in the South Nolan Creek Watershed, a few of the more pertinent BMPs relating to the current water quality impairments are discussed below.

6.1 Septic Tank Elimination Program

The Septic Tank Elimination Program provides City funding to install City sanitary sewer mains within City right of way or easements to existing properties which are served by septic tanks. The intent of the program is to eliminate existing septic tanks and to encourage connection to the City system. Installation of private service lines and closure of existing septic tanks are the responsibility of the property owner. Eligible applicants to the program are ranked with all other eligible applicants according to established criteria set by City Council.

The City of Killeen has a Septic Tank Elimination Program to extend sewer collection service to areas of the City with on site sewage facilities (OSSFs). In fiscal year 2008-2009, the City has budgeted $500,000 to fund septic tank elimination projects. Citizens must make application for the program and projects that will accommodate multiple property owners generally score higher in the

project rating process. An applicant must usually be a resident of Killeen for five years before applying for this program; however this requirement was waived for residents of the May 2004 and January 2008 Annexation Areas. Residents of these Annexation Areas are immediately eligible for this program as of the effective date of the annexation.

6.2 Public Education

The City plans to use targeted public education in certain areas of the City to address specific water quality problems. The types of public education materials that the City has used in the past or will be implementing as part of our Storm Water Management Program includes:

- Storm Water Brochures
- Fish-shaped Door Hanger (**Figure 25**) with pollution prevention tips that includes septic systems
- Storm Water Web Site
- Utility Bill Inserts
- Public Service Announcements
- School Book Covers

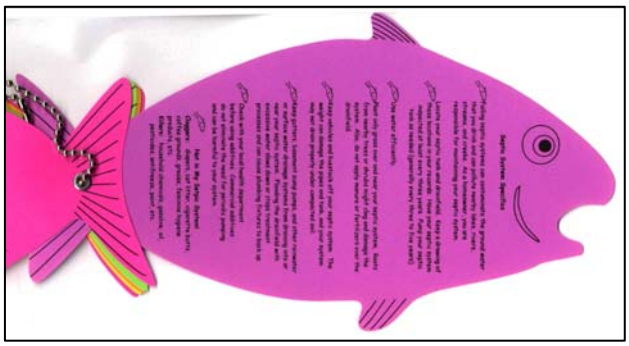

Figure 25. Fish Door Hanger with Septic Tips

6.3 SSO Reduction / I&I Studies

The City is planning an Inflow and Infiltration (I&I) Study to identify areas of the sanitary sewer system that are allowing influx of storm water, which is one of the leading causes of SSOs. The I&I study will use flow monitoring of sanitary sewer lines during dry-weather and wet-weather to determine the amount of inflow and infiltration that is occurring from storm water. Monitoring at selected locations will isolate problem areas for sanitary sewer maintenance.

6.4 Illicit Discharge Detection / Dry Weather Screening

The City has begun to address illicit discharges to its storm drain system through its Storm Water Management Program (SWMP). The Illicit Discharge Minimum Control Measure (MCM) of the Phase II MS4 General Permit requires the City to adopt an ordinance prohibiting illicit discharges, a mechanism to identify illicit discharges and enforcement procedures to eliminate the source of the illicit discharge. One method that the City will be using to identify illicit discharges is dry-weather screening. This technique utilizes portable field test kits that screen dry weather flows for common pollutants. City personnel will walk along accessible creeks during periods of dry weather and visually look for water entering the storm drain system. By strategically screening dry-weather flows, the sources can be isolated and targeted for elimination.

7.0 Identification of Priority Areas

The results of the watershed characterization and the water quality monitoring were used to determine the degree of influence that OSSFs may be having on the concentration of E. coli in the South Nolan Creek Watershed.

7.1 Relationship between OSSFs and Bacteria Concentrations

The geometric mean E. coli concentrations for each site were plotted against the cumulative number of OSSFs located above the sampling site as shown in **Figure 26**. A simple linear regression analysis was performed on the data. The regression analysis indicated a statistically significant (P=0.02) relationship between the number of OSSFs above a sampling site and the geometric mean E. coli concentrations. The P value is a computed probability for a statistical test and is used to determine if the results are statistically significant. The threshold value that is typically used is a P value of 0.05. Statistical tests with a computed P value less that 0.05 are considered statistically significant. The P value for the linear regression analysis was computed to be 0.02.

The data showed a positive relationship (R^2=0.60) that indicates that the geometric mean E. coli concentrations increase as the number of OSSFs located above the sampling site increases. The value of R^2 is a fraction between 0.0 and 1.0 that indicates how much of the variance in one variable "explains" the variation in another variable. An R^2 of 0 would indicate no relationship between the 2 variables and an R^2 of 1.0 would indicate a perfect relationship. The R^2 value that was computed for the linear regression analysis is 0.60, which indicates that 60 percent of the variation in the E. coli geometric mean concentrations can be explained by the number of OSSFs above the sampling site. Other explanatory variables, which may be responsible for the other 40 percent of the variation, include:

- proximity of OSSFs to streams
- soil types
- type of OSSF system
- age of OSSF system
- degree of OSSF maintenance
- other bacteria sources

These data were not readily available in the City of Killeen or Bell County OSSF databases and compilation of these data were beyond the scope of this study.

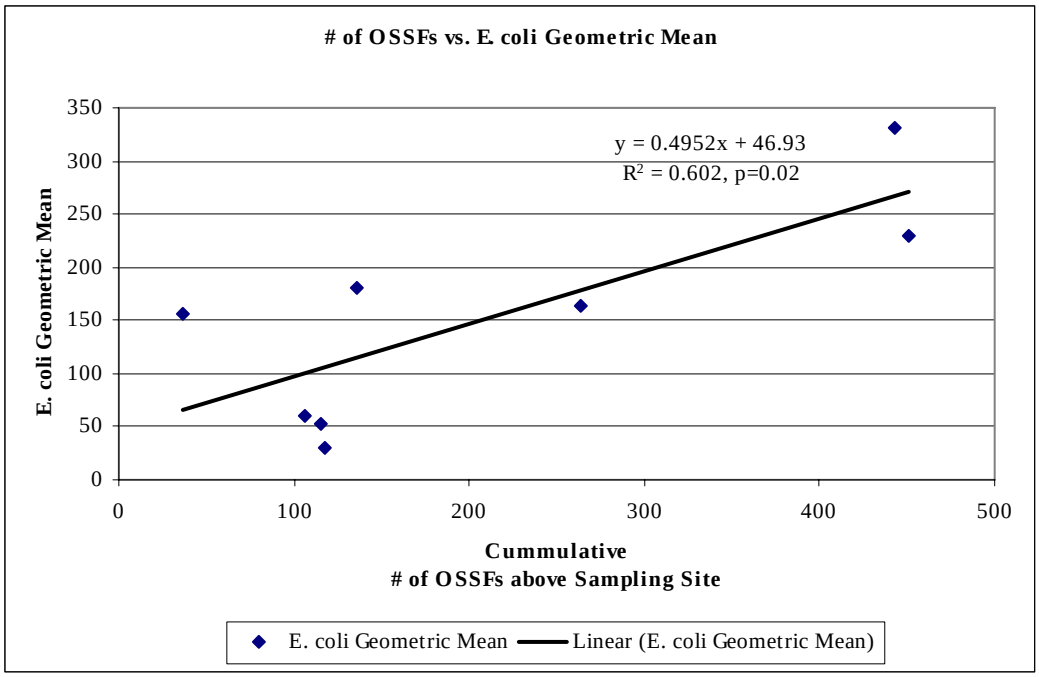

Figure 26. Relationship of E. coli Geometric Mean Concentrations to the # of OSSFs

7.2 Priority Sub-Basins

Priority sub-basins in the South Nolan Creek watershed were identified based on E. coli concentrations observed and the OSSF densities within the sub-basin. Priority sub-basins are shown in **Figure 27**.

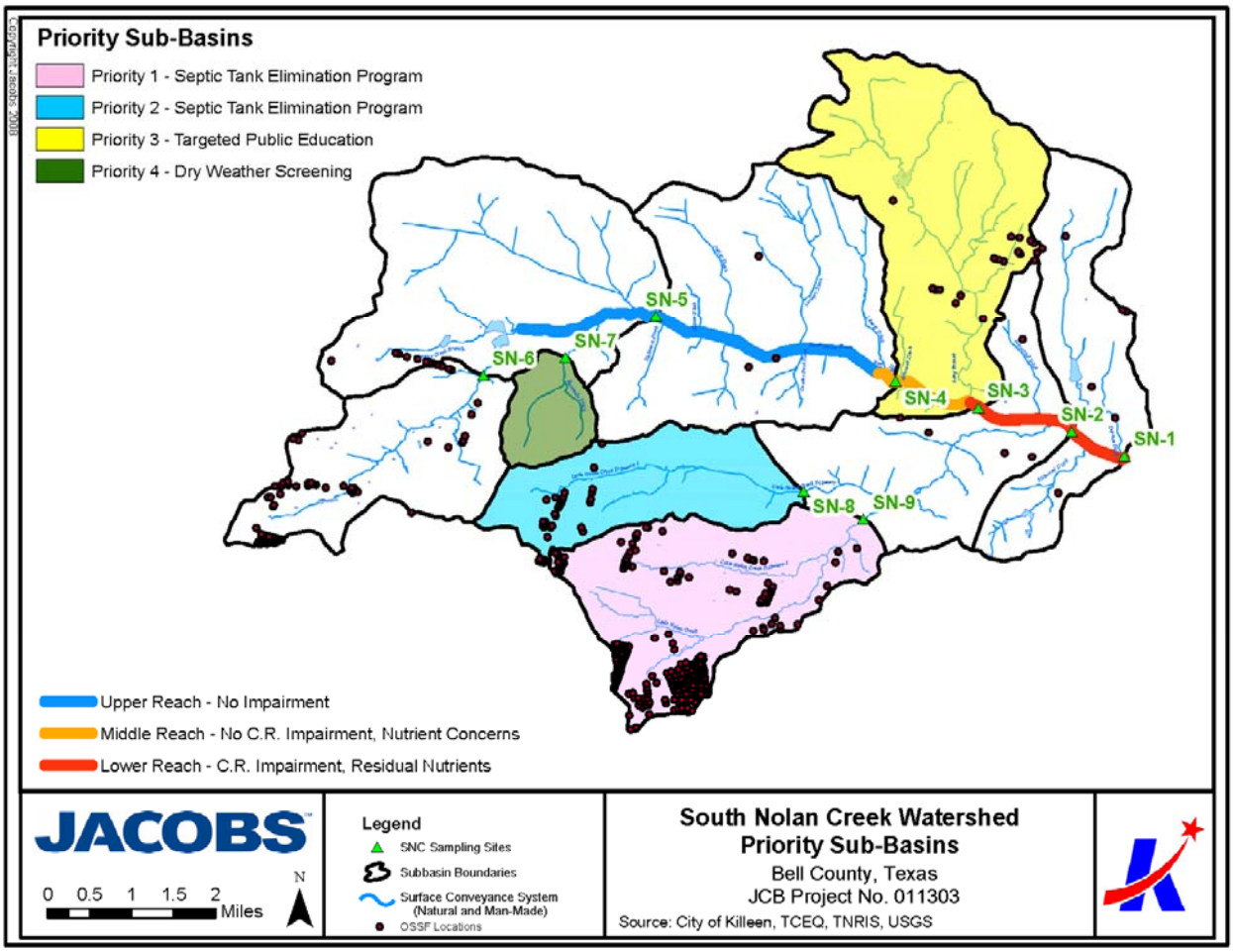

Figure 27. Priority Sub-Basins

7.2.1 Little Nolan Creek, Sub-Basin SN-9

Little Nolan Creek Tributary 2 (sub-basin SN-9) was identified as the highest priority (Priority 1) sub-basin in the South Nolan Creek Watershed. The SN-9 sub-basin contains 264 of the 451 OSSFs located in the watershed and the highest density of OSSFs (8.56/100 Ac). Water quality monitoring results at Site SN-9 (**Figure 28**) indicated that the TSWQS were exceeded 29 percent of the time. The geometric mean E. coli concentration for this site was 163 MPN/100 mL.

Figure 28. Site SN-9

The BMP recommended for implementation in this sub-basin is the Septic Tank Elimination Program, discussed previously in Section 6.1.

7.2.2 Little Nolan Creek Tributary 1, Sub-Basin SN-8

Little Nolan Creek Tributary 1 sub-basin (sub-basin SN-8) was identified as a Priority 2 sub-basin and was targeted for the City's Septic Tank Elimination Program. This sub-basin has fewer OSSFs than sub-basin SN-9, but geometric mean concentrations and the number of TSWQS exceedances were comparable to site SN-9. Sub-basin SN-8 had 37 known OSSFs in the sub-basin with a density of 1.8 per 100 acres. Twenty-one percent of the E. coli samples collected from Site SN-8 (**Figure 29**) exceeded the TSWQS criterion.

Figure 29. Site SN-8

7.2.3 Long Branch, Sub-Basin SN-3

The Long Branch Watershed (sub-basin SN-3) was identified as a Priority 3 sub-basin. Site SN-3 exhibited a geometric mean E. coli concentration above the TSWQS with 29 percent of the samples collected exceeding the single sample criterion. Only 18 OSSFs are known to exist in the SN-3 sub-basin and are widely distributed with a density of 0.4 per 100 acres. Recommended BMPs to be installed in this sub-basin include targeted public education on septic system maintenance and proper pet waste management.

7.2.4 Bermuda Ditch, Sub-Basin SN-7

Bermuda Ditch Watershed, sub-basin SN-7 was identified as a Priority 4 sub-basin and is targeted for dry weather screening to identify possible sources of the dry weather flows. Site SN-7 (**Figure 30**) was typically dry during the ambient monitoring dates. Of the 14 monthly visits to the site, sufficient flow was observed on only 5 dates for sample collection. Three of the five samples collected exceeded the TSWQS. Because no known OSSFs are located in the sub-basin, the source of dry weather flows may be due to illicit discharges to the storm drain system or illegal connections of pipes that should be plumbed to the sanitary sewer. By walking upstream along Bermuda Ditch and strategically identifying and testing flows into Bermuda Ditch, the City can determine the sources of dry weather flows and eliminate them through enforcement of the City's Illicit Discharge Ordinance.

Figure 30. Site SN-7

8.0 Conclusions and Recommendations

1. The upper portion of South Nolan Creek is meeting water quality standards from the headwaters to 38th Street (Site SN-4)
2. At Twin Creek Drive (Site SN-3) concentrations of E. coli become elevated above the TSWQS criterion due to influences from Long Branch.
3. The highest concentrations of E. coli were observed at Roy Reynolds Drive (SN-2) due to cumulative influences from Long Branch (SN-3) and Little Nolan Creek (SN-8 & SN-9).
4. Concentrations of E. coli decline downstream but are still elevated above the TSWQS criterion at Ann Boulevard (Site SN-1).
5. The E. coli data show some violations/exceedances of the E. coli criteria particularly downstream of the Long Branch confluence with South Nolan Creek. Data generated by this study may be used to break the 29 mile long segment into multiple Assessment Units (AUs).
6. The results showed a positive relationship between the E. coli geometric mean concentration and the number of OSSFs located above the sampling sites. Based on the monitoring results and watershed characteristics such as land use, soils, hydrography, and OSSF densities, the City identified four priority sub-basins for BMP implementation.
    - The Little Nolan Creek and Little Nolan Creek Tributary 1 sub-basins were identified as high priority for implementation of the City's Septic Tank Elimination Program. These sub-basins contain 301 of the 451 OSSFs located in the South Nolan Creek watershed.
    - The Long Branch sub-basin was identified as high priority for implementation of targeted public education relating to septic tank maintenance and proper pet waste management.
    - The Bermuda Ditch sub-basin contains no known OSSFs but occasional dry weather flows were observed with elevated E. coli concentrations. The City will use dry weather screening techniques to identify possible sources, which may include illicit discharges and illegal connections to the storm sewer system.

    The City will implement these BMPs through its Phase II Municipal Separate Storm Sewer System (MS4) Storm Water Management Program. The City plans to continue ambient monitoring for E. coli concentrations at 3 sites (SN-2, SN-8 and SN-9) on a quarterly basis to monitor long-term trends and characterize water quality improvements and BMP effectiveness.
7. The 6.9 mile reach of the South Nolan Creek that was monitored during this study was divided into an Upper Reach (4 miles), a Middle Reach (1.1 miles) and a Lower Reach (1.8 miles) based on the water quality monitoring results (**Figure 31**).
    - The Upper Reach from the beginning of Segment 1218 to a point immediately upstream of the Bell County wastewater treatment plant (WWTP) outfalls was characterized as meeting the designated uses and showed no impairments related to the Texas Surface Water Quality Standards (TSWQS). Dissolved oxygen (DO), pH, temperature, nutrients, metals and bacteria concentrations

met the TSWQS criteria and screening levels set by the Texas Commission on Environmental Quality (TCEQ).

- The Middle Reach met TSWQS criteria for DO, pH, temperature, metals and bacteria concentrations. Nutrient concentrations (ammonia, nitrate plus nitrite, orthophosphorus, and total phosphorus) above TCEQ screening levels were observed immediately downstream of the WWTP outfalls. While not conclusive, several water quality parameters as well as flow data suggest that the WWTP discharge may be the source of elevated nutrients. This final report recommends that a special study be conducted by TCEQ to confirm the source of elevated nutrients.
- The Lower Reach met TSWQS criteria for DO, pH, temperature, and metals. Nutrient concentrations generally declined but remained elevated above TCEQ screening levels. Elevated bacteria concentrations were observed and the number of exceedances and the geometric mean confirm impairment of the contact recreation use due to OSSF influences from Long Branch and Little Nolan Creek.

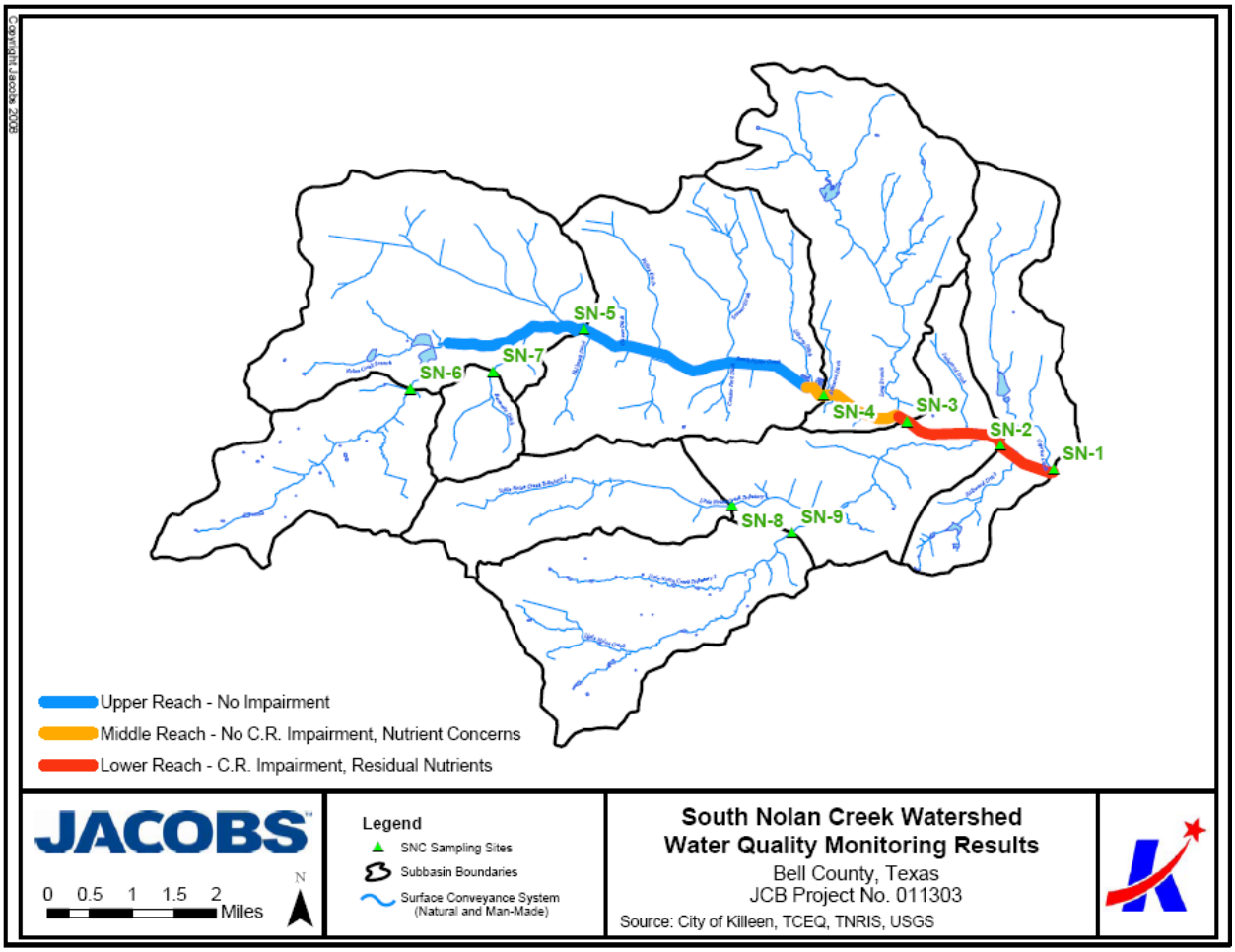

Figure 31. Assessment Results Identifying Impairments and Concerns

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Appendix A: Exhibits/Maps

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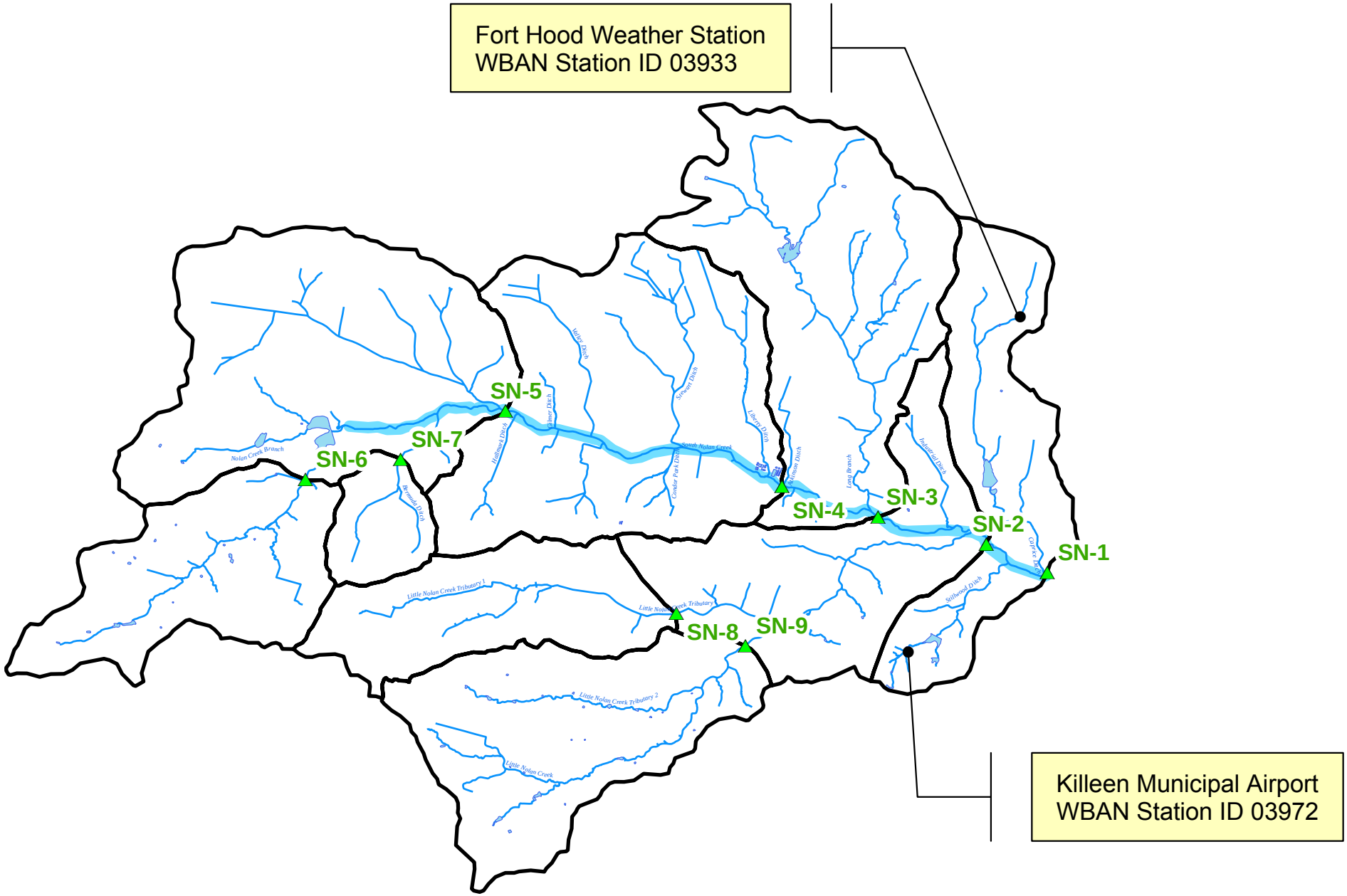

JACOBS™

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Legend

- SNC Sampling Sites
- Subbasin Boundaries
- Surface Conveyance System (Natural and Man-Made)
- Segment 1218
- NCDC Climatological Stations

South Nolan Creek Watershed Climatological Station

Bell County, Texas

JCB Project No. 011303

Source: City of Killeen, TCEQ, TNRIS, USGS, NCDC

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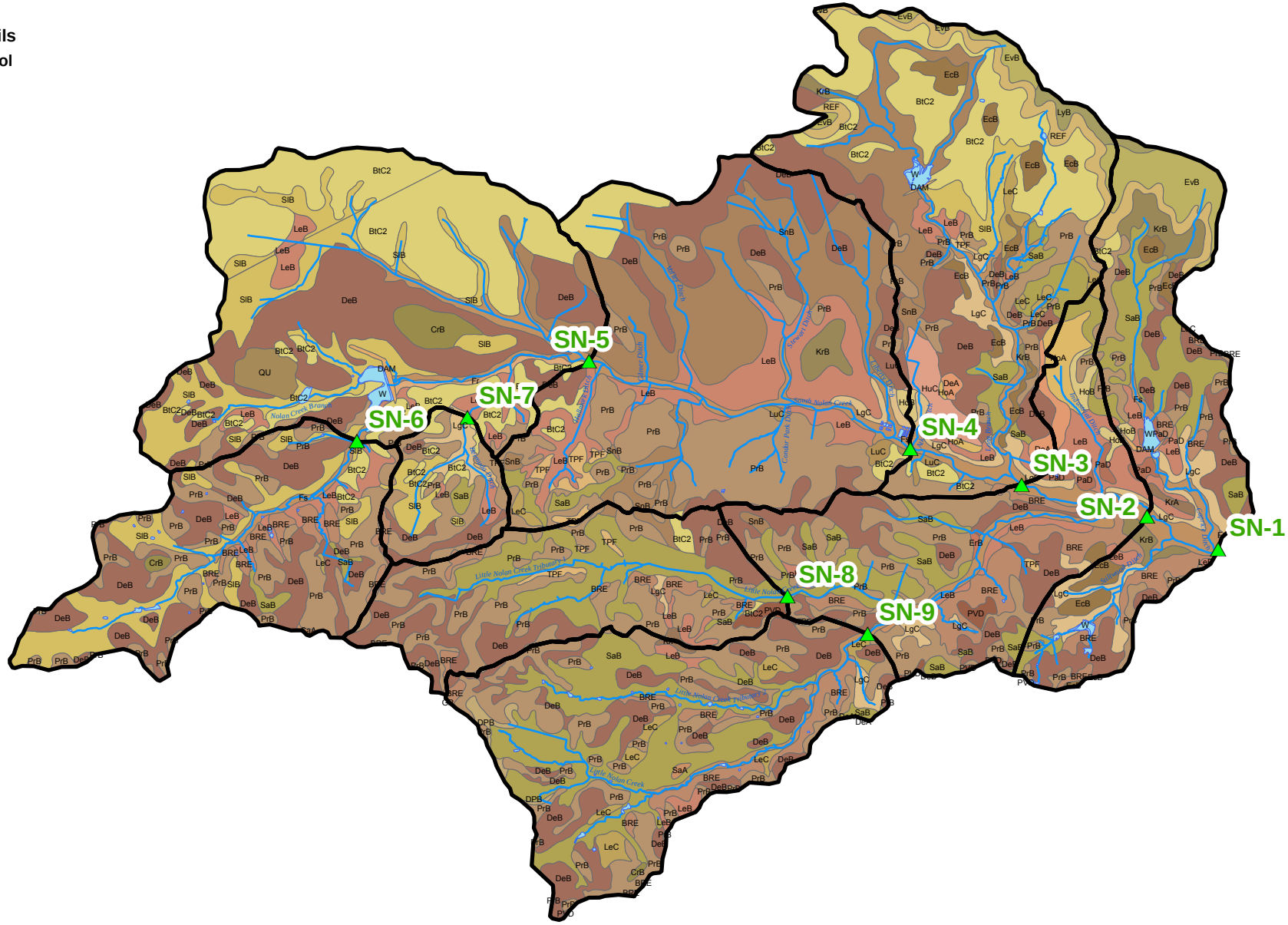

JACOBS™

0 0.5 1 1.5 2 Miles

N

Legend

- SNC Sampling Sites
- Subbasin Boundaries
- Surface Conveyance System (Natural and Man-Made)

South Nolan Creek Watershed SSURGO Soil Data

Bell County, Texas

JCB Project No. 011303

Source: City of Killeen, TCEQ, NRCS, TNRIS, USGS

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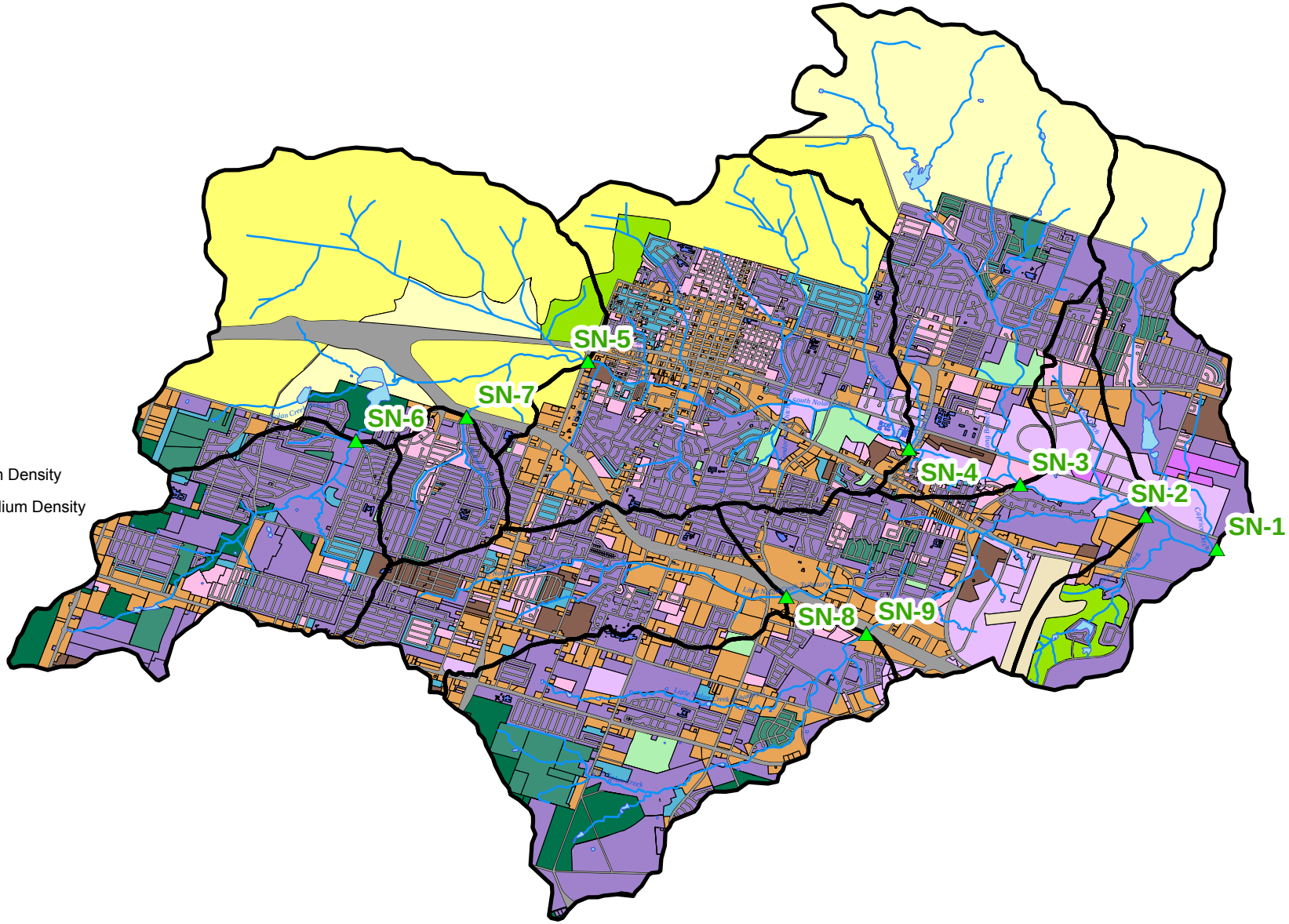
South Nolan Creek Watershed

Landuse

- Agricultural
- Airport
- Commercial
- Duplex
- Golf Course
- Heavy Industrial
- Light Industrial
- Institutional / Schools
- Military Base - Developed
- Military Base - Undeveloped
- Multi-Family Residential
- Mobile/Manufactured Homes
- Municipal Park
- Single Family Residential - High Density
- Single Family Residential - Medium Density
- Transportation / Roads
- Water



JACOBS™

0 0.5 1 1.5 2 Miles

N

Legend

- SNC Sampling Sites
- Subbasin Boundaries
- Surface Conveyance System (Natural and Man-Made)

South Nolan Creek Watershed Land Use Map

Bell County, Texas
JCB Project No. 011303

Source: City of Killeen, TCEQ, TNRIS, USGS

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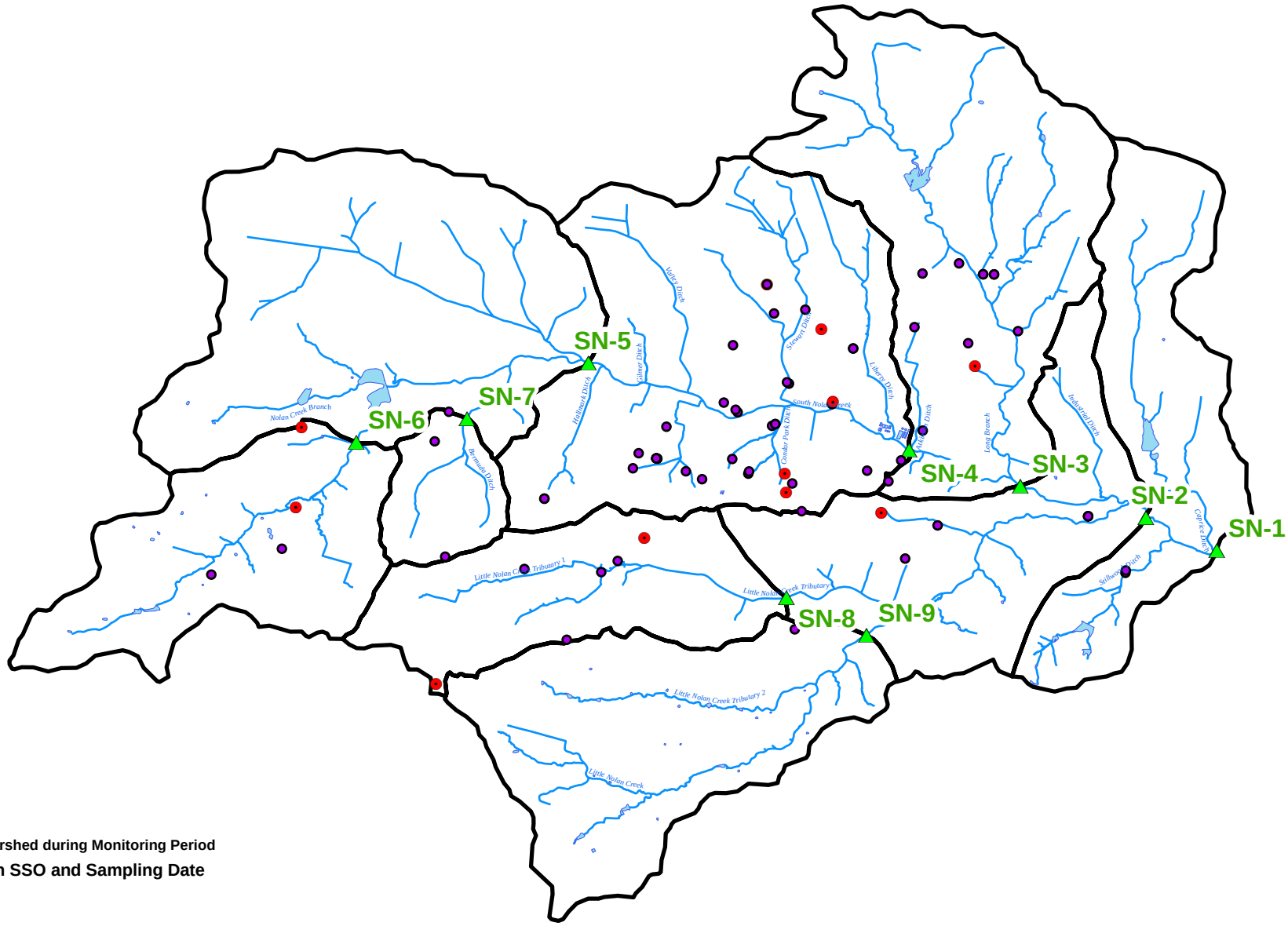

SSOs in SNC Watershed during Monitoring Period

Interval between SSO and Sampling Date

- > 7 days
- < 7 days

JACOBS™

0 0.5 1 1.5 2 Miles

N

Legend

- SNC Sampling Sites
- Subbasin Boundaries
- Surface Conveyance System (Natural and Man-Made)

South Nolan Creek Watershed Sanitary Sewer Overflow (SSO) Locations

Bell County, Texas

JCB Project No. 011303

Source: City of Killeen, TCEQ, TNRIS, USGS

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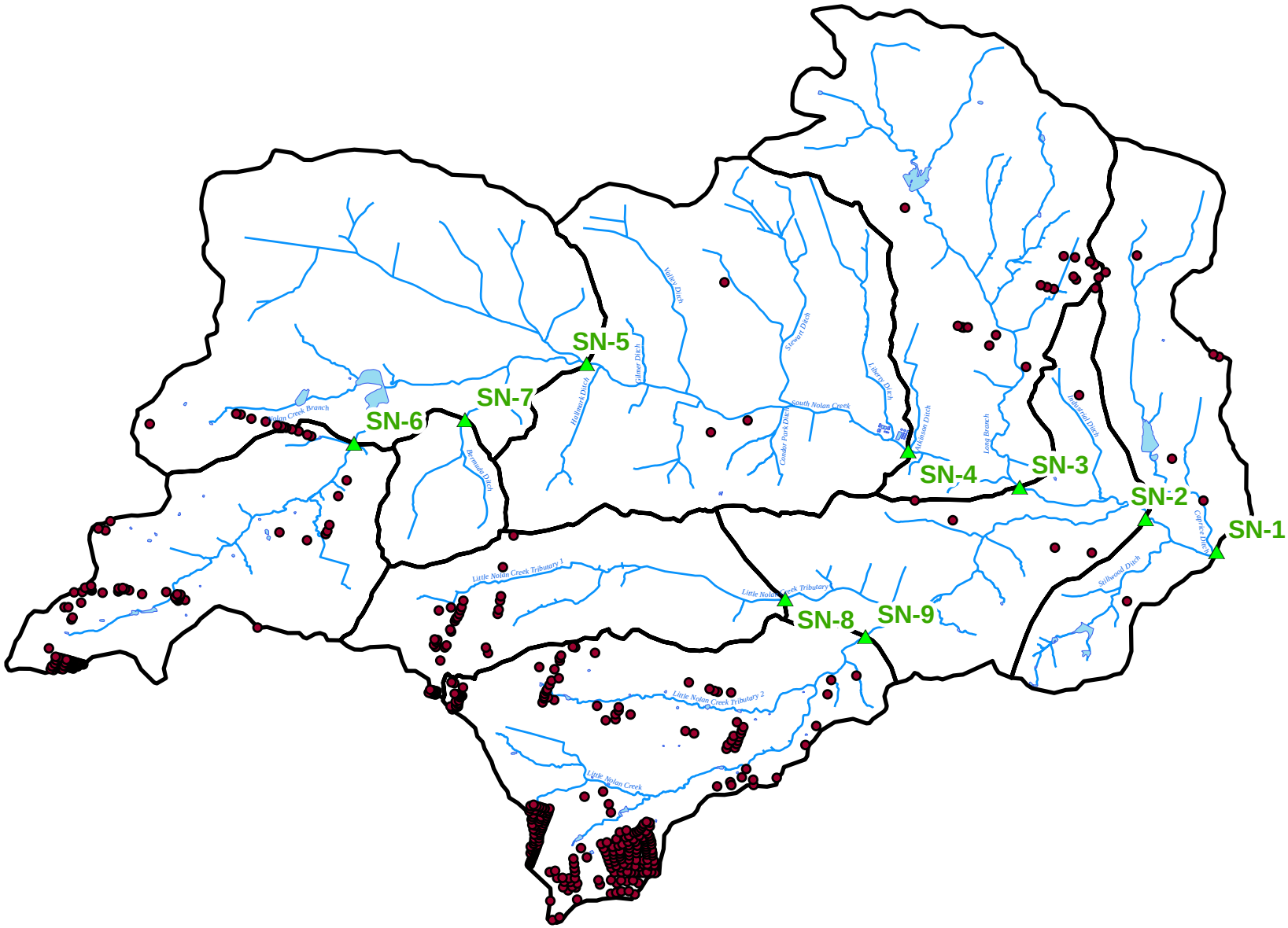

JACOBS™

0 0.5 1 1.5 2 Miles

N

Legend

- SNC Sampling Sites
- Subbasin Boundaries
- Surface Conveyance System (Natural and Man-Made)
- Killeen OSSF Coverage

South Nolan Creek Watershed On-Site Sewage Facility Locations

Bell County, Texas

JCB Project No. 011303

Source: City of Killeen, TCEQ, TNRIS, USGS

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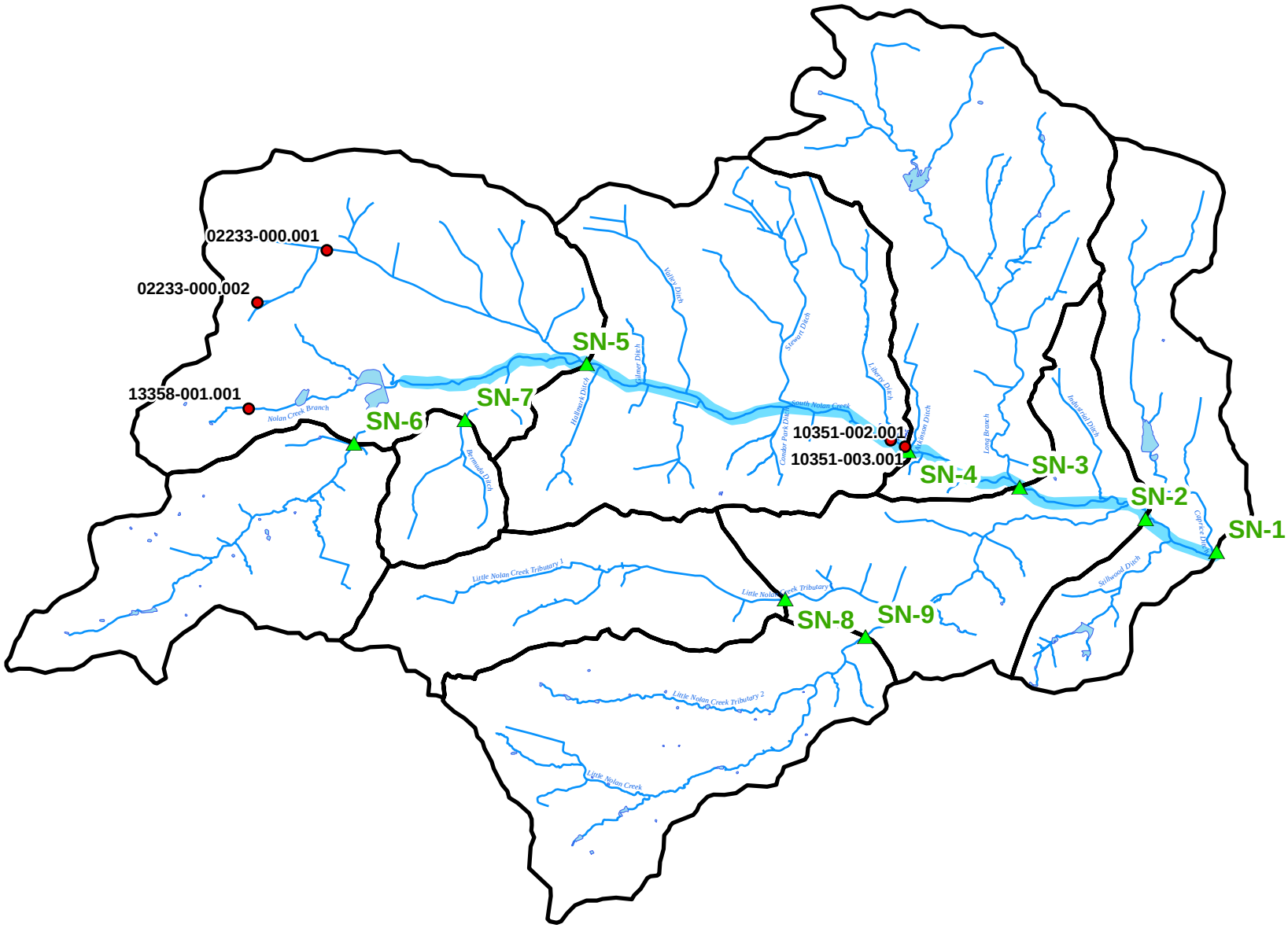


JACOBS™

0 0.5 1 1.5 2 Miles

N

Legend

- SNC Sampling Sites
- SNC Wastewater Outfalls
- Subbasin Boundaries
- Surface Conveyance System (Natural and Man-Made)
- Segment 1218

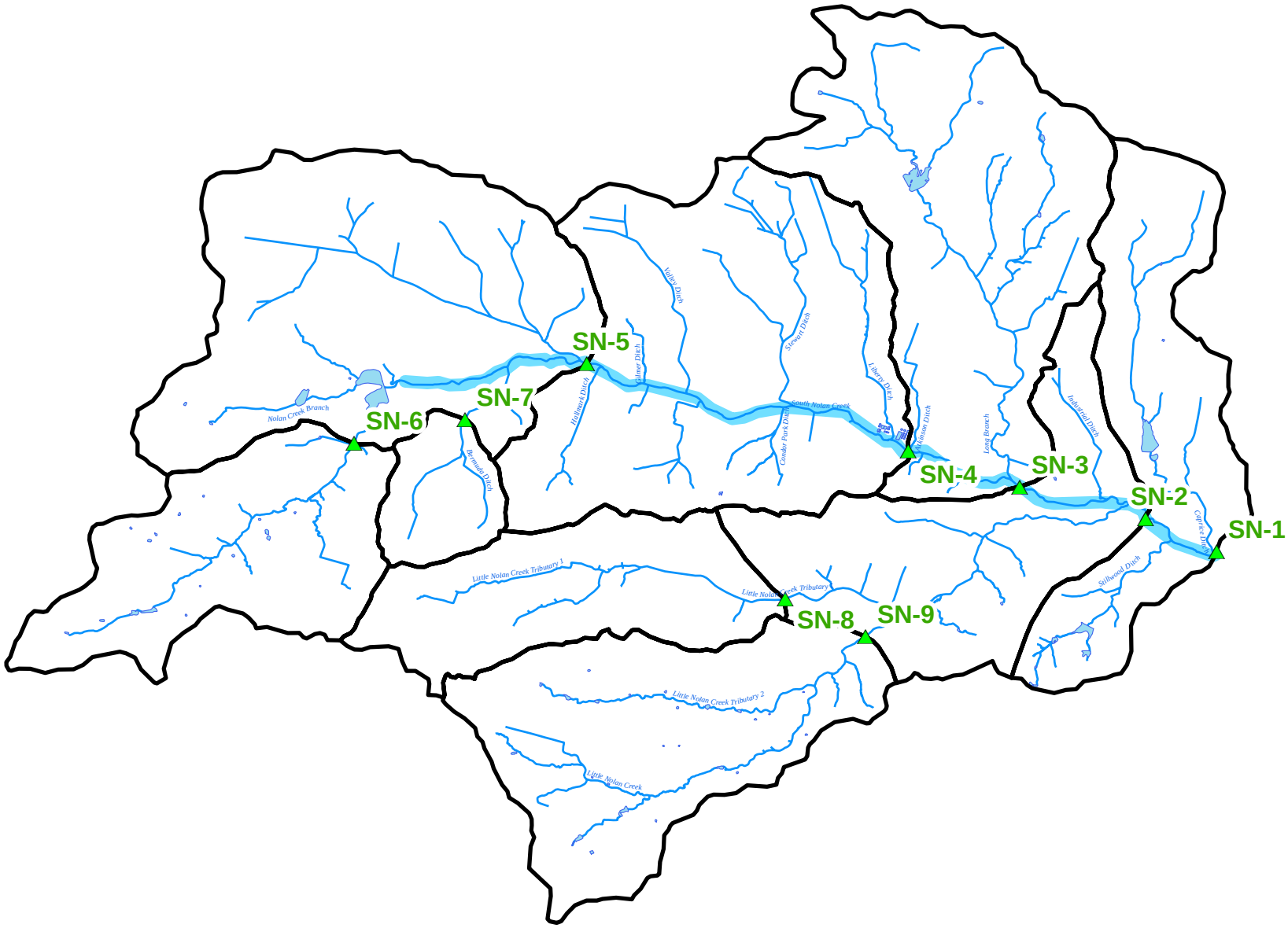
South Nolan Creek Watershed Wastewater Discharge Permit Outfalls

Bell County, Texas

JCB Project No. 011303

Source: City of Killeen, TCEQ

Copyright Jacobs 2008



JACOBS™

0 0.5 1 1.5 2 Miles

N

Legend

- SNC Sampling Sites
- Subbasin Boundaries
- Surface Conveyance System (Natural and Man-Made)
- Segment 1218

South Nolan Creek Watershed Sampling Sites

Bell County, Texas

JCB Project No. 011303

Source: City of Killeen, TCEQ, TNRIS, USGS

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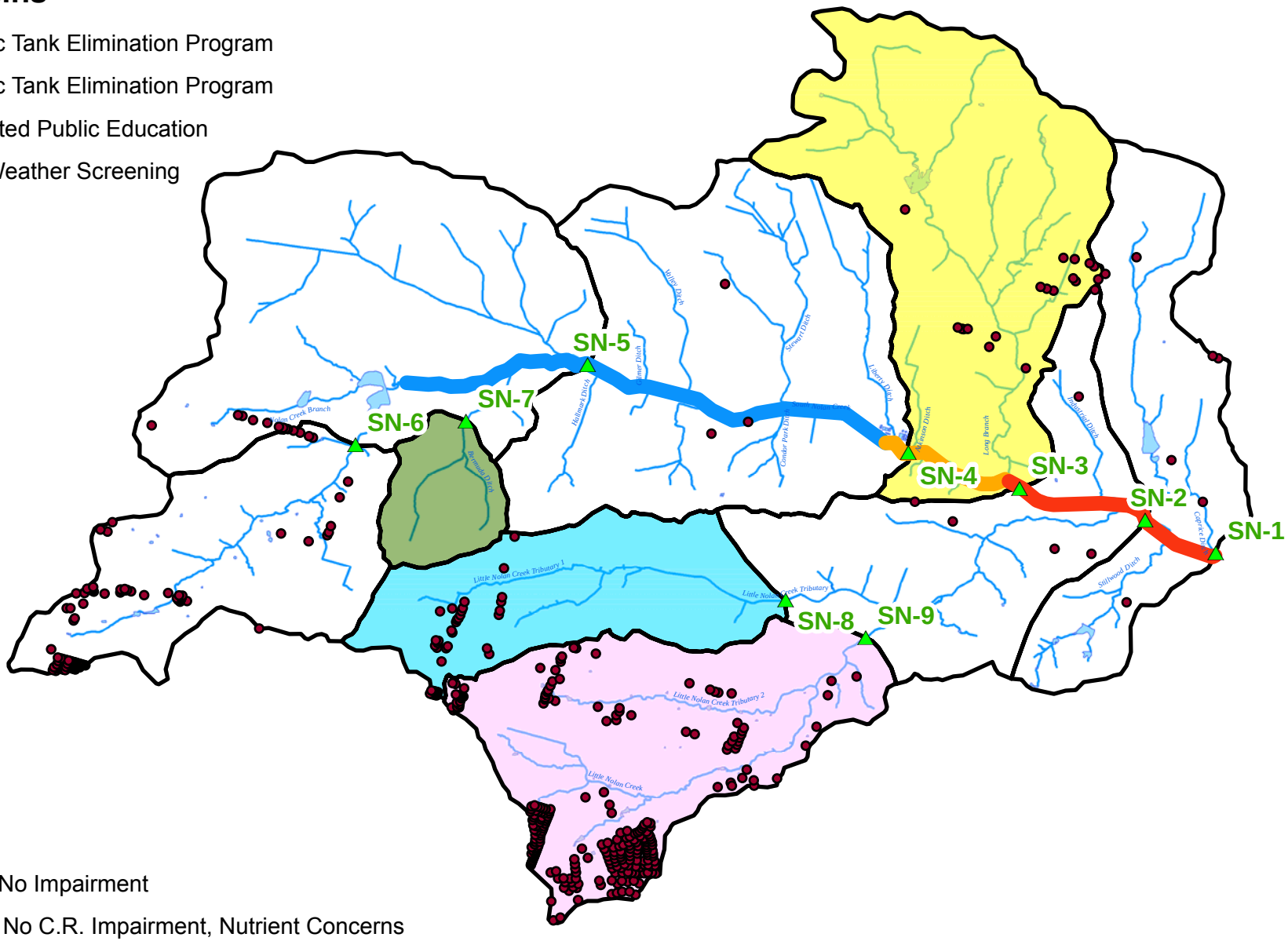
Priority Sub-Basins

- Priority 1 - Septic Tank Elimination Program
- Priority 2 - Septic Tank Elimination Program
- Priority 3 - Targeted Public Education
- Priority 4 - Dry Weather Screening



- Upper Reach - No Impairment
- Middle Reach - No C.R. Impairment, Nutrient Concerns
- Lower Reach - C.R. Impairment, Residual Nutrients

JACOBS™

0 0.5 1 1.5 2 Miles

N

Legend

- SNC Sampling Sites
- Subbasin Boundaries
- Surface Conveyance System (Natural and Man-Made)
- OSSF Locations

South Nolan Creek Watershed
Priority Sub-Basins

Bell County, Texas
JCB Project No. 011303

Source: City of Killeen, TCEQ, TNRIS, USGS

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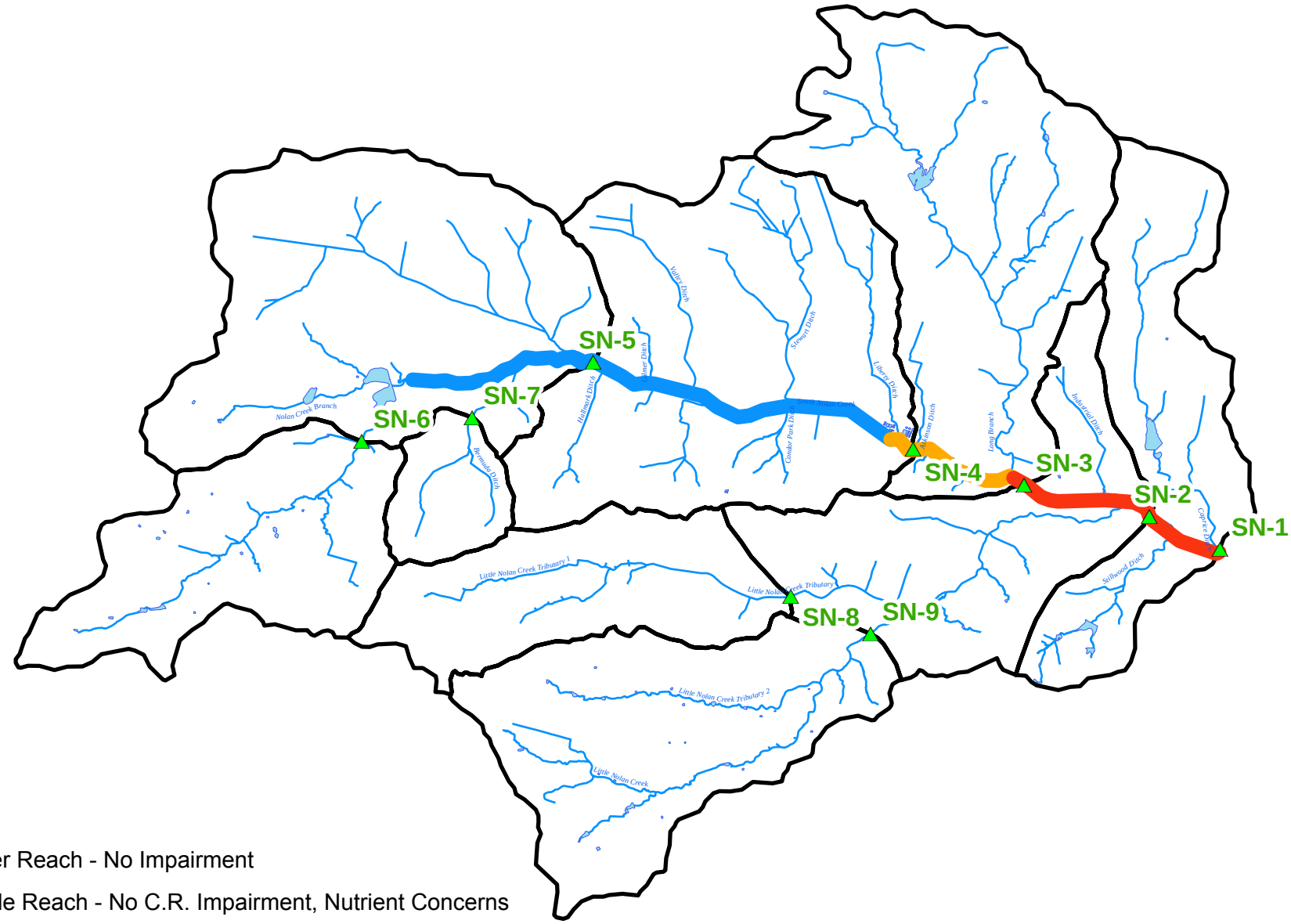


Upper Reach - No Impairment

Middle Reach - No C.R. Impairment, Nutrient Concerns

Lower Reach - C.R. Impairment, Residual Nutrients

JACOBS™

0 0.5 1 1.5 2 Miles

N

Legend

- SNC Sampling Sites
- Subbasin Boundaries
- Surface Conveyance System (Natural and Man-Made)

South Nolan Creek Watershed Water Quality Monitoring Results

Bell County, Texas

JCB Project No. 011303

Source: City of Killeen, TCEQ, TNRIS, USGS

Appendix B: Watershed Characteristics

Table B-1. Number of OSSFs in each Sub-basin and Soil Types

Sub-Basin	Soil	Soil Description	Number of OSSFs	Suitability for Septic Tank Drain Fields Limitation	Factors Affecting Suitability			
					Flooding	Slow Water Movement	Depth to Bedrock	Large Stone Content
SN-1	Fs	Frio silty clay, 0 to 1 % slopes, frequently flooded	1	Very	X	X	X	
	LeB	Lewisville silty clay, 1 to 3 % slopes	1	Somewhat		X		
	LgC	Lewisville-Altoga complex, 2 to 5 % slopes	1	Somewhat		X		
	PrB	Purves silty clay, 1 to 4 % slopes	4	Very			X	
	SaB	San Saba clay, 1 to 3 % slopes	1	Very		X	X	
SN-2	DeB	Denton silty clay, 1 to 3 % slopes	1	Very		X	X	
	EcB	Eckrant cobbly silty clay, 1 to 5 % slopes	1	Very			X	X
	HoB	Houston Black clay, 1 to 3 % slopes	1	Very		X		
	LeC	Lewisville silty clay, 3 to 5 % slopes	1	Somewhat		X		
	PrB	Purves silty clay, 1 to 4 % slopes	2	Very			X	
SN-3	DeB	Denton silty clay, 1 to 3 % slopes	5	Very		X	X	
	EcB	Eckrant cobbly silty clay, 1 to 5 % slopes	2	Very			X	X
	LeC	Lewisville silty clay, 3 to 5 % slopes	1	Somewhat		X		
	PrB	Purves silty clay, 1 to 4 % slopes	4	Very			X	
	SaB	San Saba clay, 1 to 3 % slopes	5	Very		X	X	
	SnB	San Saba-Urban land complex, 0 to 3 % slopes	1	Very		X	X	
SN-4	PrB	Purves silty clay, 1 to 4 % slopes	2	Very			X	
	SnB	San Saba-Urban land complex, 0 to 3 % slopes	1	Very		X	X	
SN-5	BtC2	Topsey clay loam, 3 to 8 % slopes, severely eroded	1	Very		X		
	LeB	Lewisville silty clay, 1 to 3 % slopes	3	Somewhat		X		
	PrB	Purves silty clay, 1 to 4 % slopes	4	Very			X	
	SlB	Slidell silty clay, 0 to 2 % slopes	1	Very		X		
SN-6	BRE	Brackett association, 8 to 12 % slopes	4	Very		X		
	BtC2	Topsey clay loam, 3 to 8 % slopes, severely eroded	2	Very		X		
	DeB	Denton silty clay, 1 to 3 % slopes	37	Very		X	X	
	PrB	Purves silty clay, 1 to 4 % slopes	54	Very			X	
	SlB	Slidell silty clay, 0 to 2 % slopes	9	Very		X		
SN-8	BRE	Brackett association, 8 to 12 % slopes	1	Very		X		
	DeB	Denton silty clay, 1 to 3 % slopes	19	Very		X	X	
	PrB	Purves silty clay, 1 to 4 % slopes	16	Very			X	
	SaB	San Saba clay, 1 to 3 % slopes	1	Very		X	X	
SN-9	BRE	Brackett association, 8 to 12 % slopes	13	Very		X		
	CrB	Crawford silty clay, 1 to 3 % slopes	5	Very		X	X	
	DeB	Denton silty clay, 1 to 3 % slopes	68	Very		X	X	
	DPB	Denton silty clay, 1 to 3 % slopes	3	Very		X	X	
	LeC	Lewisville silty clay, 3 to 5 % slopes	19	Somewhat		X		
	LgC	Lewisville-Altoga complex, 2 to 5 % slopes	1	Somewhat		X		
	PrB	Purves silty clay, 1 to 4 % slopes	111	Very			X	
	SaB	San Saba clay, 1 to 3 % slopes	44	Very		X	X	

Table B-2. Cross Reference Between City Zoning Categories to Land Use Categories

Zoning Code	Zoning Description	Land Use Code	Land Use Description
A A-R1	Agricultural Agricultural single-family residential district	AGR	Agricultural
B-1 B-2 B-3 B-4 B-5 BC-1 B-DC BT1 RC-1 SUP	Professional business district Local retail district Local business district Business district Business district General business and alcohol sales district Business day care district Business - movie theater Restaurant and alcohol sales district Special Use/Specific Use permit	COM	Commercial
R2	Two-family residential district	DUP	2 Family Residential - Duplex
M-1	Manufacturing district	IDL	Light Industrial
M-2	Heavy manufacturing district	IDH	Heavy Industrial
R3	Multifamily residential district	MFR	Multi-Family Residential
RM-1 RMH R-MP R-MS	Residential modular home single-family district Residential mobile home Mobile home and travel trailer park district Manufactured housing subdivision district	MMH	Mobile/Manufactured Homes
RT1 CUP R1 PUD	Residential townhouse single-family district Community Unit Plan Single-family residential district Planned Unit Development	SFM	Single Family Residential - Medium Density
R1-A R1X	Single-family garden home residential district Single-family garden home residential district	SFL	Single Family Residential - High Density
	New Land Use classifications determined from aerials and data provided by the City	AIR	Airport
		GLF	Golf Courses
		INS	Institutional / Schools
		MBD	Military Base - Developed
		MBU	Military Base - Undeveloped
		PRK	Municipal Parks
		TRN	Transportation (including ROW)
		WTR	Water

Table B-3. Discharge Monitoring Report – WQ0013358-001

PERMITTEE NAME **UNIVERSAL SERVICES FORT HOOD, INC.**
EPA ID **TX0101869**
TPDES ID **13358001**
SEG ID **1218**
OUTFALL NO **001**

MONITORING END DATE	PARAMETER	QUAN AVG	QUAN MAX	QUAN UNIT	CONC MIN	CONC AVG	CONC MAX	CONC UNIT
10/31/2006	OXYGEN, DISSOLVED (DO)							MG/L
11/30/2006	OXYGEN, DISSOLVED (DO)				4.4			MG/L
12/31/2006	OXYGEN, DISSOLVED (DO)				5.2			MG/L
1/31/2007	OXYGEN, DISSOLVED (DO)				6.1			MG/L
2/28/2007	OXYGEN, DISSOLVED (DO)				5.5			MG/L
3/31/2007	OXYGEN, DISSOLVED (DO)				5.2			MG/L
4/30/2007	OXYGEN, DISSOLVED (DO)				5.3			MG/L
5/31/2007	OXYGEN, DISSOLVED (DO)				5.0			MG/L
6/30/2007	OXYGEN, DISSOLVED (DO)				4.5			MG/L
7/31/2007	OXYGEN, DISSOLVED (DO)				5.2			MG/L
8/31/2007	OXYGEN, DISSOLVED (DO)				4.2			MG/L
9/30/2007	OXYGEN, DISSOLVED (DO)				4.5			MG/L
10/31/2007	OXYGEN, DISSOLVED (DO)				5.6			MG/L
11/30/2007	OXYGEN, DISSOLVED (DO)				5.1			MG/L
12/31/2007	OXYGEN, DISSOLVED (DO)				4.5			MG/L
1/31/2008	OXYGEN, DISSOLVED (DO)				5.3			MG/L
2/29/2008	OXYGEN, DISSOLVED (DO)				5.2			MG/L
10/31/2006	BOD, 5-DAY (20 DEG. C)			LBS/DY				MG/L
11/30/2006	BOD, 5-DAY (20 DEG. C)	1.52		LBS/DY		4.4	8.0	MG/L
12/31/2006	BOD, 5-DAY (20 DEG. C)	1.13		LBS/DY		3.25	5.0	MG/L
1/31/2007	BOD, 5-DAY (20 DEG. C)	2.72		LBS/DY		5.5	10.0	MG/L
2/28/2007	BOD, 5-DAY (20 DEG. C)	1.71		LBS/DY		4.25	5.0	MG/L
3/31/2007	BOD, 5-DAY (20 DEG. C)	2.41		LBS/DY		4.2	5.0	MG/L
4/30/2007	BOD, 5-DAY (20 DEG. C)	2.13		LBS/DY		3.5	5.0	MG/L
5/31/2007	BOD, 5-DAY (20 DEG. C)	1.84		LBS/DY		3.2	5.0	MG/L
6/30/2007	BOD, 5-DAY (20 DEG. C)	2.30		LBS/DY		4.0	6.0	MG/L
7/31/2007	BOD, 5-DAY (20 DEG. C)	2.02		LBS/DY		3.5	5.0	MG/L
8/31/2007	BOD, 5-DAY (20 DEG. C)	2.15		LBS/DY		5.6	6.0	MG/L
9/30/2007	BOD, 5-DAY (20 DEG. C)	2.06		LBS/DY		5.25	7.0	MG/L
10/31/2007	BOD, 5-DAY (20 DEG. C)	2.78		LBS/DY		7.0	11.0	MG/L
11/30/2007	BOD, 5-DAY (20 DEG. C)	3.51		LBS/DY		7.6	8.0	MG/L
12/31/2007	BOD, 5-DAY (20 DEG. C)	2.66		LBS/DY		7.0	9.0	MG/L
1/31/2008	BOD, 5-DAY (20 DEG. C)	2.36		LBS/DY		5.8	8.0	MG/L
2/29/2008	BOD, 5-DAY (20 DEG. C)	2.23		LBS/DY		6.0	7.0	MG/L
10/31/2006	PH							SU
11/30/2006	PH				7.2		7.9	SU
12/31/2006	PH				7.2		7.6	SU
1/31/2007	PH				7.2		7.9	SU
2/28/2007	PH				7.1		7.9	SU
3/31/2007	PH				7.1		7.6	SU
4/30/2007	PH				7.1		7.6	SU
5/31/2007	PH				7.2		7.9	SU
6/30/2007	PH				7.1		7.6	SU
7/31/2007	PH				7.2		7.6	SU
8/31/2007	PH				7.1		7.7	SU
9/30/2007	PH				7.1		7.6	SU
10/31/2007	PH				7.1		7.6	SU
11/30/2007	PH				7.1		7.8	SU
12/31/2007	PH				7.2		7.9	SU
1/31/2008	PH				7.2		7.9	SU
2/29/2008	PH				7.1		7.9	SU

PERMITTEE NAME **UNIVERSAL SERVICES FORT HOOD, INC.**
EPA ID **TX0101869**
TPDES ID **13358001**
SEG ID **1218**
OUTFALL NO **001**

MONITORING END DATE	PARAMETER	QUAN AVG	QUAN MAX	QUAN UNIT	CONC MIN	CONC AVG	CONC MAX	CONC UNIT
10/31/2006	SOLIDS, TOTAL SUSPENDED			LBS/DY				MG/L
11/30/2006	SOLIDS, TOTAL SUSPENDED	2.18		LBS/DY		6.4	15.0	MG/L
12/31/2006	SOLIDS, TOTAL SUSPENDED	1.13		LBS/DY		3.25	6.0	MG/L
1/31/2007	SOLIDS, TOTAL SUSPENDED	3.68		LBS/DY		7.5	14.0	MG/L
2/28/2007	SOLIDS, TOTAL SUSPENDED	2.04		LBS/DY		5.0	6.0	MG/L
3/31/2007	SOLIDS, TOTAL SUSPENDED	2.97		LBS/DY		5.4	7.0	MG/L
4/30/2007	SOLIDS, TOTAL SUSPENDED	1.56		LBS/DY		2.75	3.0	MG/L
5/31/2007	SOLIDS, TOTAL SUSPENDED	1.55		LBS/DY		2.6	3.0	MG/L
6/30/2007	SOLIDS, TOTAL SUSPENDED	1.17		LBS/DY		2.0	2.0	MG/L
7/31/2007	SOLIDS, TOTAL SUSPENDED	2.38		LBS/DY		2.0	2.0	MG/L
8/31/2007	SOLIDS, TOTAL SUSPENDED	0.852		LBS/DY		2.2	3.0	MG/L
9/30/2007	SOLIDS, TOTAL SUSPENDED	0.78		LBS/DY		2.0	2.0	MG/L
10/31/2007	SOLIDS, TOTAL SUSPENDED	1.01		LBS/DY		7.5	3.0	MG/L
11/30/2007	SOLIDS, TOTAL SUSPENDED	7.96		LBS/DY		4.2	5.0	MG/L
12/31/2007	SOLIDS, TOTAL SUSPENDED	1.33		LBS/DY		3.5	5.0	MG/L
1/31/2008	SOLIDS, TOTAL SUSPENDED	1.63		LBS/DY		5.0	6.0	MG/L
2/29/2008	SOLIDS, TOTAL SUSPENDED	1.04		LBS/DY		2.75	3.0	MG/L
10/31/2006	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD				
11/30/2006	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	0.039	0.050	MGD				
12/31/2006	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	0.043	0.050	MGD				
1/31/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	0.053	0.074	MGD				
2/28/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	0.0488	0.069	MGD				
3/31/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	0.065	0.090	MGD				
4/30/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	0.066	0.090	MGD				
5/31/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	0.0706	0.090	MGD				
6/30/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	0.073	0.090	MGD				
7/31/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	0.075	0.090	MGD				
8/31/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	0.053	0.068	MGD				
9/30/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	0.046	0.059	MGD				
10/31/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	0.052	0.063	MGD				
11/30/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	0.053	0.069	MGD				
12/31/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	0.047	0.057	MGD				
1/31/2008	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	0.052	0.069	MGD				
2/29/2008	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	0.047	0.055	MGD				
10/31/2006	CHLORINE, TOTAL RESIDUAL							MG/L
11/30/2006	CHLORINE, TOTAL RESIDUAL				1.1		1.6	MG/L
12/31/2006	CHLORINE, TOTAL RESIDUAL				1.1		1.7	MG/L
1/31/2007	CHLORINE, TOTAL RESIDUAL				1.1		1.6	MG/L
2/28/2007	CHLORINE, TOTAL RESIDUAL				1.1		1.6	MG/L
3/31/2007	CHLORINE, TOTAL RESIDUAL				1.1		1.8	MG/L
4/30/2007	CHLORINE, TOTAL RESIDUAL				1.2		1.9	MG/L
5/31/2007	CHLORINE, TOTAL RESIDUAL				1.1		1.9	MG/L
6/30/2007	CHLORINE, TOTAL RESIDUAL				1.2		1.8	MG/L
7/31/2007	CHLORINE, TOTAL RESIDUAL				1.0		1.6	MG/L
8/31/2007	CHLORINE, TOTAL RESIDUAL				1.1		1.6	MG/L
9/30/2007	CHLORINE, TOTAL RESIDUAL				1.0		1.5	MG/L
10/31/2007	CHLORINE, TOTAL RESIDUAL				1.2		1.6	MG/L
11/30/2007	CHLORINE, TOTAL RESIDUAL				1.1		1.6	MG/L
12/31/2007	CHLORINE, TOTAL RESIDUAL				1.1		2.0	MG/L
1/31/2008	CHLORINE, TOTAL RESIDUAL				1.1		1.6	MG/L
2/29/2008	CHLORINE, TOTAL RESIDUAL				1.1		1.6	MG/L

Table B-4. Discharge Monitoring Report – WQ0002233-000

PERMITTEE NAME **US DEPARTMENT OF THE ARMY**
EPA ID **TX0002313**
TPDES ID **02233000**
SEG ID **1218**
OUTFALL NO **001A**

MONITORING END DATE	PARAMETER	QUAN AVG	QUAN MAX	QUAN UNIT	CONC MIN	CONC AVG	CONC MAX	CONC UNIT	NO DISCHARGE INDICATOR
10/31/2006	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
11/30/2006	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
12/31/2006	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
1/31/2007	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
2/28/2007	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
3/31/2007	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
4/30/2007	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
5/31/2007	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
6/30/2007	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
7/31/2007	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
8/31/2007	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
9/30/2007	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
10/31/2007	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
11/30/2007	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
12/31/2007	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
1/31/2008	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
2/29/2008	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
10/31/2006	PH							SU	NO DISCHARGE
11/30/2006	PH							SU	NO DISCHARGE
12/31/2006	PH							SU	NO DISCHARGE
1/31/2007	PH							SU	NO DISCHARGE
2/28/2007	PH							SU	NO DISCHARGE
3/31/2007	PH							SU	NO DISCHARGE
4/30/2007	PH							SU	NO DISCHARGE
5/31/2007	PH							SU	NO DISCHARGE
6/30/2007	PH							SU	NO DISCHARGE
7/31/2007	PH							SU	NO DISCHARGE
8/31/2007	PH							SU	NO DISCHARGE
9/30/2007	PH							SU	NO DISCHARGE
10/31/2007	PH							SU	NO DISCHARGE
11/30/2007	PH							SU	NO DISCHARGE
12/31/2007	PH							SU	NO DISCHARGE
1/31/2008	PH							SU	NO DISCHARGE
2/29/2008	PH							SU	NO DISCHARGE
10/31/2006	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
11/30/2006	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
12/31/2006	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
1/31/2007	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
2/28/2007	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
3/31/2007	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
4/30/2007	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
5/31/2007	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
6/30/2007	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
7/31/2007	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
8/31/2007	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
9/30/2007	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
10/31/2007	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
11/30/2007	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
12/31/2007	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
1/31/2008	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
2/29/2008	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
10/31/2006	OIL & GREASE							MG/L	NO DISCHARGE
11/30/2006	OIL & GREASE							MG/L	NO DISCHARGE
12/31/2006	OIL & GREASE							MG/L	NO DISCHARGE
1/31/2007	OIL & GREASE							MG/L	NO DISCHARGE
2/28/2007	OIL & GREASE							MG/L	NO DISCHARGE
3/31/2007	OIL & GREASE							MG/L	NO DISCHARGE

MONITORING END DATE	PARAMETER	QUAN AVG	QUAN MAX	QUAN UNIT	CONC MIN	CONC AVG	CONC MAX	CONC UNIT	NO DISCHARGE INDICATOR
4/30/2007	OIL & GREASE							MG/L	NO DISCHARGE
5/31/2007	OIL & GREASE							MG/L	NO DISCHARGE
6/30/2007	OIL & GREASE							MG/L	NO DISCHARGE
7/31/2007	OIL & GREASE							MG/L	NO DISCHARGE
8/31/2007	OIL & GREASE							MG/L	NO DISCHARGE
9/30/2007	OIL & GREASE							MG/L	NO DISCHARGE
10/31/2007	OIL & GREASE							MG/L	NO DISCHARGE
11/30/2007	OIL & GREASE							MG/L	NO DISCHARGE
12/31/2007	OIL & GREASE							MG/L	NO DISCHARGE
1/31/2008	OIL & GREASE							MG/L	NO DISCHARGE
2/29/2008	OIL & GREASE							MG/L	NO DISCHARGE
10/31/2006	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
11/30/2006	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
12/31/2006	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
1/31/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
2/28/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
3/31/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
4/30/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
5/31/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
6/30/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
7/31/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
8/31/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
9/30/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
10/31/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
11/30/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
12/31/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
1/31/2008	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
2/29/2008	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE

PERMITTEE NAME **US DEPARTMENT OF THE ARMY**
EPA ID **TX0002313**
TPDES ID **02233000**
SEG ID **1218**
OUTFALL NO **002A**

MONITORING END DATE	PARAMETER	QUAN AVG	QUAN MAX	QUAN UNIT	CONC MIN	CONC AVG	CONC MAX	CONC UNIT	NO DISCHARGE INDICATOR
10/31/2006	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
11/30/2006	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
12/31/2006	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
1/31/2007	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
2/28/2007	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
3/31/2007	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
4/30/2007	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
5/31/2007	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
6/30/2007	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
7/31/2007	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
8/31/2007	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
9/30/2007	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
10/31/2007	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
11/30/2007	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
12/31/2007	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
1/31/2008	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
2/29/2008	OXYGEN DEMAND, CHEM. (HIGH LEVEL) (COD)							MG/L	NO DISCHARGE
10/31/2006	PH							SU	NO DISCHARGE
11/30/2006	PH							SU	NO DISCHARGE
12/31/2006	PH							SU	NO DISCHARGE
1/31/2007	PH							SU	NO DISCHARGE
2/28/2007	PH							SU	NO DISCHARGE
3/31/2007	PH							SU	NO DISCHARGE
4/30/2007	PH							SU	NO DISCHARGE
5/31/2007	PH							SU	NO DISCHARGE
6/30/2007	PH							SU	NO DISCHARGE

MONITORING END DATE	PARAMETER	QUAN AVG	QUAN MAX	QUAN UNIT	CONC MIN	CONC AVG	CONC MAX	CONC UNIT	NO DISCHARGE INDICATOR
7/31/2007	PH							SU	NO DISCHARGE
8/31/2007	PH							SU	NO DISCHARGE
9/30/2007	PH							SU	NO DISCHARGE
10/31/2007	PH							SU	NO DISCHARGE
11/30/2007	PH							SU	NO DISCHARGE
12/31/2007	PH							SU	NO DISCHARGE
1/31/2008	PH							SU	NO DISCHARGE
2/29/2008	PH							SU	NO DISCHARGE
10/31/2006	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
11/30/2006	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
12/31/2006	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
1/31/2007	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
2/28/2007	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
3/31/2007	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
4/30/2007	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
5/31/2007	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
6/30/2007	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
7/31/2007	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
8/31/2007	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
9/30/2007	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
10/31/2007	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
11/30/2007	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
12/31/2007	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
1/31/2008	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
2/29/2008	SOLIDS, TOTAL SUSPENDED							MG/L	NO DISCHARGE
10/31/2006	OIL & GREASE							MG/L	NO DISCHARGE
11/30/2006	OIL & GREASE							MG/L	NO DISCHARGE
12/31/2006	OIL & GREASE							MG/L	NO DISCHARGE
1/31/2007	OIL & GREASE							MG/L	NO DISCHARGE
2/28/2007	OIL & GREASE							MG/L	NO DISCHARGE
3/31/2007	OIL & GREASE							MG/L	NO DISCHARGE
4/30/2007	OIL & GREASE							MG/L	NO DISCHARGE
5/31/2007	OIL & GREASE							MG/L	NO DISCHARGE
6/30/2007	OIL & GREASE							MG/L	NO DISCHARGE
7/31/2007	OIL & GREASE							MG/L	NO DISCHARGE
8/31/2007	OIL & GREASE							MG/L	NO DISCHARGE
9/30/2007	OIL & GREASE							MG/L	NO DISCHARGE
10/31/2007	OIL & GREASE							MG/L	NO DISCHARGE
11/30/2007	OIL & GREASE							MG/L	NO DISCHARGE
12/31/2007	OIL & GREASE							MG/L	NO DISCHARGE
1/31/2008	OIL & GREASE							MG/L	NO DISCHARGE
2/29/2008	OIL & GREASE							MG/L	NO DISCHARGE
10/31/2006	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
11/30/2006	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
12/31/2006	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
1/31/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
2/28/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
3/31/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
4/30/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
5/31/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
6/30/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
7/31/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
8/31/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
9/30/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
10/31/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
11/30/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
12/31/2007	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
1/31/2008	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE
2/29/2008	FLOW, IN CONDUIT OR THRU TREATMENT PLANT			MGD					NO DISCHARGE

Table B-5. Discharge Monitoring Report – WQ0010351-002

PERMITTEE NAME **BELL COUNTY WCID NO. 1**
EPA ID **TX0024597**
TPDES ID **10351002**
SEG ID **1218**
OUTFALL NO **001A**

MONITORING END DATE	OUTFALL NO	PARAMETER	QUAN AVG	QUAN MAX	QUAN UNIT	CONC MIN	CONC AVG	CONC MAX	CONC UNIT	NO DISCHARGE INDICATOR
10/31/2006	001A	OXYGEN, DISSOLVED (DO)				6.10			MG/L	
11/30/2006	001A	OXYGEN, DISSOLVED (DO)				6.8			MG/L	
12/31/2006	001A	OXYGEN, DISSOLVED (DO)				7.5			MG/L	
1/31/2007	001A	OXYGEN, DISSOLVED (DO)				7.2			MG/L	
2/28/2007	001A	OXYGEN, DISSOLVED (DO)				7.7			MG/L	
3/31/2007	001A	OXYGEN, DISSOLVED (DO)				7.8			MG/L	
4/30/2007	001A	OXYGEN, DISSOLVED (DO)				7.5			MG/L	
10/31/2006	001A	PH				7.1		7.5	SU	
11/30/2006	001A	PH				6.5		7.4	SU	
12/31/2006	001A	PH				7.0		7.6	SU	
1/31/2007	001A	PH				7.1		7.6	SU	
2/28/2007	001A	PH				7.2		7.5	SU	
3/31/2007	001A	PH				7.1		7.4	SU	
4/30/2007	001A	PH				7.3		7.6	SU	
10/31/2006	001A	SOLIDS, TOTAL SUSPENDED	74		LBS/DY		1.0	1.16	MG/L	
11/30/2006	001A	SOLIDS, TOTAL SUSPENDED	81.8		LBS/DY		1.17	4	MG/L	
12/31/2006	001A	SOLIDS, TOTAL SUSPENDED	87		LBS/DY		1.21	2.32	MG/L	
1/31/2007	001A	SOLIDS, TOTAL SUSPENDED	555		LBS/DY		4.93	14.36	MG/L	
2/28/2007	001A	SOLIDS, TOTAL SUSPENDED	199.7		LBS/DY		2.7	9.94	MG/L	
3/31/2007	001A	SOLIDS, TOTAL SUSPENDED	196		LBS/DY		2.12	7.6	MG/L	
4/30/2007	001A	SOLIDS, TOTAL SUSPENDED	88		LBS/DY		1.02	1.26	MG/L	
10/31/2006	001A	NITROGEN, AMMONIA TOTAL (AS N)	47		LBS/DY		.638	5.6	MG/L	
11/30/2006	001A	NITROGEN, AMMONIA TOTAL (AS N)	19.1		LBS/DY		.274	3.5	MG/L	
12/31/2006	001A	NITROGEN, AMMONIA TOTAL (AS N)	27.4		LBS/DY		.36	4.9	MG/L	
1/31/2007	001A	NITROGEN, AMMONIA TOTAL (AS N)	18.4		LBS/DY		.17	1.1	MG/L	
2/28/2007	001A	NITROGEN, AMMONIA TOTAL (AS N)	13		LBS/DY		.19	1.7	MG/L	
3/31/2007	001A	NITROGEN, AMMONIA TOTAL (AS N)	17.4		LBS/DY		.19	.84	MG/L	
4/30/2007	001A	NITROGEN, AMMONIA TOTAL (AS N)	57		LBS/DY		.63	4.6	MG/L	
10/31/2006	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		12654	GPM					
11/30/2006	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		9722	GPM					
12/31/2006	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		10455	GPM					
1/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		17901	GPM					
2/28/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		11227	GPM					
3/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		17978	GPM					
4/30/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		13619	GPM					
10/31/2006	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	8.91		MGD					
11/30/2006	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	8.89		MGD					
12/31/2006	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	8.96		MGD					
1/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	9.3		MGD					
2/28/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	9.42		MGD					
3/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	9.58		MGD					
4/30/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	9.6		MGD					
10/31/2006	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	8.87	11.7	MGD					
11/30/2006	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	8.36	9.14	MGD					
12/31/2006	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	8.99	11.9	MGD					
1/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	12.18	17.76	MGD					
2/28/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	9.52	14.1	MGD					
3/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	11.4	23.2	MGD					
4/30/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	10.67	21	MGD					
10/31/2006	001A	CHLORINE, TOTAL RESIDUAL						.08	MG/L	
11/30/2006	001A	CHLORINE, TOTAL RESIDUAL						.07	MG/L	
12/31/2006	001A	CHLORINE, TOTAL RESIDUAL						.06	MG/L	
1/31/2007	001A	CHLORINE, TOTAL RESIDUAL						.08	MG/L	
2/28/2007	001A	CHLORINE, TOTAL RESIDUAL						.05	MG/L	
3/31/2007	001A	CHLORINE, TOTAL RESIDUAL						.05	MG/L	
4/30/2007	001A	CHLORINE, TOTAL RESIDUAL						.03	MG/L	
10/31/2006	001A	CHLORINE, TOTAL RESIDUAL				.86			MG/L	
11/30/2006	001A	CHLORINE, TOTAL RESIDUAL				.6			MG/L	
12/31/2006	001A	CHLORINE, TOTAL RESIDUAL				.76			MG/L	
1/31/2007	001A	CHLORINE, TOTAL RESIDUAL				.76			MG/L	
2/28/2007	001A	CHLORINE, TOTAL RESIDUAL				.75			MG/L	
3/31/2007	001A	CHLORINE, TOTAL RESIDUAL				.73			MG/L	
4/30/2007	001A	CHLORINE, TOTAL RESIDUAL				.51			MG/L	

PERMITTEE NAME **BELL COUNTY WCID NO. 1**
EPA ID **TX0024597**
TPDES ID **10351002**
SEG ID **1218**
OUTFALL NO **001A**

MONITORING END DATE	OUTFALL NO	PARAMETER	QUAN AVG	QUAN MAX	QUAN UNIT	CONC MIN	CONC AVG	CONC MAX	CONC UNIT	NO DISCHARGE INDICATOR
10/31/2006	001A	BOD, CARBONACEOUS 05 DAY, 20C	163		LBS/DY		2.21	4.08	MG/L	
11/30/2006	001A	BOD, CARBONACEOUS 05 DAY, 20C	146		LBS/DY		2.09	3	MG/L	
12/31/2006	001A	BOD, CARBONACEOUS 05 DAY, 20C	177		LBS/DY		2.37	4.03	MG/L	
1/31/2007	001A	BOD, CARBONACEOUS 05 DAY, 20C	230		LBS/DY		2.31	4.5	MG/L	
2/28/2007	001A	BOD, CARBONACEOUS 05 DAY, 20C	153		LBS/DY		2.13	3.18	MG/L	
3/31/2007	001A	BOD, CARBONACEOUS 05 DAY, 20C	198		LBS/DY		2.08	2.32	MG/L	
4/30/2007	001A	BOD, CARBONACEOUS 05 DAY, 20C	179		LBS/DY		2.07	2.16	MG/L	
5/31/2007	001A	OXYGEN, DISSOLVED (DO)				6.6			MG/L	
6/30/2007	001A	OXYGEN, DISSOLVED (DO)				6.8			MG/L	
7/31/2007	001A	OXYGEN, DISSOLVED (DO)				6.5			MG/L	
8/31/2007	001A	OXYGEN, DISSOLVED (DO)				6.6			MG/L	
9/30/2007	001A	OXYGEN, DISSOLVED (DO)				6.3			MG/L	
10/31/2007	001A	OXYGEN, DISSOLVED (DO)				6.5			MG/L	
11/30/2007	001A	OXYGEN, DISSOLVED (DO)				7.10			MG/L	
12/31/2007	001A	OXYGEN, DISSOLVED (DO)				7.5			MG/L	
1/31/2008	001A	OXYGEN, DISSOLVED (DO)				7.7			MG/L	
2/29/2008	001A	OXYGEN, DISSOLVED (DO)				7.6			MG/L	
5/31/2007	001A	PH				7.3		7.8	SU	
6/30/2007	001A	PH				7.2		7.8	SU	
7/31/2007	001A	PH				6.9		7.7	SU	
8/31/2007	001A	PH				7.2		7.8	SU	
9/30/2007	001A	PH				7.2		7.7	SU	
10/31/2007	001A	PH				6.9		7.6	SU	
11/30/2007	001A	PH				6.7		7.3	SU	
12/31/2007	001A	PH				6.8		7.4	SU	
1/31/2008	001A	PH				6.9		7.4	SU	
2/29/2008	001A	PH				7.0		7.4	SU	
5/31/2007	001A	SOLIDS, TOTAL SUSPENDED	7019		LBS/DY		4.61	24.44	MG/L	
6/30/2007	001A	SOLIDS, TOTAL SUSPENDED	168		LBS/DY		1.19	3.32	MG/L	
7/31/2007	001A	SOLIDS, TOTAL SUSPENDED	182		LBS/DY		1.4	8.1	MG/L	
8/31/2007	001A	SOLIDS, TOTAL SUSPENDED	86.5		LBS/DY		1.11	4	MG/L	
9/30/2007	001A	SOLIDS, TOTAL SUSPENDED	74		LBS/DY		1.03	1.16	MG/L	
10/31/2007	001A	SOLIDS, TOTAL SUSPENDED	86		LBS/DY		1.26	8.94	MG/L	
11/30/2007	001A	SOLIDS, TOTAL SUSPENDED	68		LBS/DY		1.03	1.68	MG/L	
12/31/2007	001A	SOLIDS, TOTAL SUSPENDED	75		LBS/DY		1.1	1.86	MG/L	
1/31/2008	001A	SOLIDS, TOTAL SUSPENDED	117		LBS/DY		1.64	2.62	MG/L	
2/29/2008	001A	SOLIDS, TOTAL SUSPENDED	103		LBS/DY		1.44	3.18	MG/L	
5/31/2007	001A	NITROGEN, AMMONIA TOTAL (AS N)	40		LBS/DY		.3	2	MG/L	
6/30/2007	001A	NITROGEN, AMMONIA TOTAL (AS N)	37		LBS/DY		.31	1.6	MG/L	
7/31/2007	001A	NITROGEN, AMMONIA TOTAL (AS N)	15.5		LBS/DY		.13	.27	MG/L	
8/31/2007	001A	NITROGEN, AMMONIA TOTAL (AS N)	11.2		LBS/DY		.14	.26	MG/L	
9/30/2007	001A	NITROGEN, AMMONIA TOTAL (AS N)	9.52		LBS/DY		.13	.26	MG/L	
10/31/2007	001A	NITROGEN, AMMONIA TOTAL (AS N)	10.2		LBS/DY		.15	.35	MG/L	
11/30/2007	001A	NITROGEN, AMMONIA TOTAL (AS N)	12		LBS/DY		.18	.72	MG/L	
12/31/2007	001A	NITROGEN, AMMONIA TOTAL (AS N)	9.7		LBS/DY		.14	.25	MG/L	
1/31/2008	001A	NITROGEN, AMMONIA TOTAL (AS N)	.15		LBS/DY		.22	.39	MG/L	
2/29/2008	001A	NITROGEN, AMMONIA TOTAL (AS N)	12		LBS/DY		.17	.58	MG/L	
5/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		30440	GPM					
6/30/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		23071	GPM					
7/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		22878	GPM					
8/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		9028	GPM					
9/30/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		10417	GPM					
10/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		9028	GPM					
11/30/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		8719	GPM					
12/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		8873	GPM					
1/31/2008	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		8989	GPM					
2/29/2008	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		7793	GPM					
5/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	10.12		MGD					
6/30/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	10.7		MGD					
7/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	11.18		MGD					
8/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	11.24		MGD					
9/30/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	11.25		MGD					
10/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	11.21		MGD					

PERMITTEE NAME **BELL COUNTY WCID NO. 1**
EPA ID **TX0024597**
TPDES ID **10351002**
SEG ID **1218**
OUTFALL NO **001A**

MONITORING END DATE	OUTFALL NO	PARAMETER	QUAN AVG	QUAN MAX	QUAN UNIT	CONC MIN	CONC AVG	CONC MAX	CONC UNIT	NO DISCHARGE INDICATOR
11/30/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	11.19		MGD					
12/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	11.12		MGD					
1/31/2008	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	10.8		MGD					
2/29/2008	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	10.8		MGD					
5/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	15.97	40.91	MGD					
6/30/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	16.02	28.0	MGD					
7/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	14.55	24.97	MGD					
8/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	9.36	12.35	MGD					
9/30/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	8.95	11.16	MGD					
10/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	8.36	9.55	MGD					
11/30/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	8.13	10.17	MGD					
12/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	8.15	9.84	MGD					
1/31/2008	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	8.41	10.18	MGD					
2/29/2008	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	9.13	16.4	MGD					
5/31/2007	001A	CHLORINE, TOTAL RESIDUAL						.03	MG/L	
6/30/2007	001A	CHLORINE, TOTAL RESIDUAL						.08	MG/L	
7/31/2007	001A	CHLORINE, TOTAL RESIDUAL						.07	MG/L	
8/31/2007	001A	CHLORINE, TOTAL RESIDUAL						.07	MG/L	
9/30/2007	001A	CHLORINE, TOTAL RESIDUAL						.09	MG/L	
10/31/2007	001A	CHLORINE, TOTAL RESIDUAL						.06	MG/L	
11/30/2007	001A	CHLORINE, TOTAL RESIDUAL						.08	MG/L	
12/31/2007	001A	CHLORINE, TOTAL RESIDUAL						.06	MG/L	
1/31/2008	001A	CHLORINE, TOTAL RESIDUAL						.03	MG/L	
2/29/2008	001A	CHLORINE, TOTAL RESIDUAL						.07	MG/L	
5/31/2007	001A	CHLORINE, TOTAL RESIDUAL				.51			MG/L	
6/30/2007	001A	CHLORINE, TOTAL RESIDUAL				.86			MG/L	
7/31/2007	001A	CHLORINE, TOTAL RESIDUAL				.64			MG/L	
8/31/2007	001A	CHLORINE, TOTAL RESIDUAL				.88			MG/L	
9/30/2007	001A	CHLORINE, TOTAL RESIDUAL				.97			MG/L	
10/31/2007	001A	CHLORINE, TOTAL RESIDUAL				.94			MG/L	
11/30/2007	001A	CHLORINE, TOTAL RESIDUAL				1.06			MG/L	
12/31/2007	001A	CHLORINE, TOTAL RESIDUAL				1.0			MG/L	
1/31/2008	001A	CHLORINE, TOTAL RESIDUAL				1.0			MG/L	
2/29/2008	001A	CHLORINE, TOTAL RESIDUAL				1.02			MG/L	
5/31/2007	001A	BOD, CARBONACEOUS 05 DAY, 20C	179		LBS/DY		2.07	2.16	MG/L	
6/30/2007	001A	BOD, CARBONACEOUS 05 DAY, 20C	268		LBS/DY		2.07	2.07	MG/L	
7/31/2007	001A	BOD, CARBONACEOUS 05 DAY, 20C	246		LBS/DY		2.09	2.69	MG/L	
8/31/2007	001A	BOD, CARBONACEOUS 05 DAY, 20C	165		LBS/DY		2.1	2.26	MG/L	
9/30/2007	001A	BOD, CARBONACEOUS 05 DAY, 20C	150		LBS/DY		2.07	2.21	MG/L	
10/31/2007	001A	BOD, CARBONACEOUS 05 DAY, 20C	145		LBS/DY		2.08	2.53	MG/L	
11/30/2007	001A	BOD, CARBONACEOUS 05 DAY, 20C	136		LBS/DY		2.07	2.16	MG/L	
12/31/2007	001A	BOD, CARBONACEOUS 05 DAY, 20C	145		LBS/DY		2.14	3.52	MG/L	
1/31/2008	001A	BOD, CARBONACEOUS 05 DAY, 20C	159		LBS/DY		2.26	3.15	MG/L	
2/29/2008	001A	BOD, CARBONACEOUS 05 DAY, 20C	158		LBS/DY		2.22	3.24	MG/L	

Table B-6. Discharge Monitoring Report – WQ0010351-003

PERMITTEE NAME **BELL COUNTY WCID NO. 1**
EPA ID **TX0102938**
TPDES ID **10351003**
SEG ID **1218**
OUTFALL NO **001A**

MONITORING END DATE	OUTFALL NO	PARAMETER	QUAN AVG	QUAN MAX	QUAN UNIT	CONC MIN	CONC AVG	CONC MAX	CONC UNIT	NO DISCHARGE INDICATOR
10/31/2006	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		5748	GPM					
11/30/2006	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		3897	GPM					
12/31/2006	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		5015	GPM					
1/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		7870	GPM					
2/28/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		4282	GPM					
3/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		10995	GPM					
4/30/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		5826	GPM					
5/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		9375	GPM					
6/30/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		5556	GPM					
7/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		5476	GPM					
8/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		2276	GPM					
9/30/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		2315	GPM					
10/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		2276	GPM					
11/30/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		2006	GPM					
12/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		1929	GPM					
1/31/2008	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		3742	GPM					
2/29/2008	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT		3472	GPM					
10/31/2006	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	3.722		MGD					
11/30/2006	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	3.695		MGD					
12/31/2006	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	3.69		MGD					
1/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	3.87		MGD					
2/28/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	3.87		MGD					
3/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	1.0		MGD					
4/30/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	4.11		MGD					
5/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	4.29		MGD					
6/30/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	4.32		MGD					
7/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	4.33		MGD					
8/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	4.19		MGD					
9/30/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	4.08		MGD					
10/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	3.91		MGD					
11/30/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	3.77		MGD					
12/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	3.63		MGD					
1/31/2008	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	3.29		MGD					
2/29/2008	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	3.10		MGD					
10/31/2006	001A	OXYGEN, DISSOLVED (DO)				7.3			MG/L	
11/30/2006	001A	OXYGEN, DISSOLVED (DO)				7.0			MG/L	
12/31/2006	001A	OXYGEN, DISSOLVED (DO)				7.3			MG/L	
1/31/2007	001A	OXYGEN, DISSOLVED (DO)				6.3			MG/L	
2/28/2007	001A	OXYGEN, DISSOLVED (DO)				8.0			MG/L	
3/31/2007	001A	OXYGEN, DISSOLVED (DO)				8.2			MG/L	
4/30/2007	001A	OXYGEN, DISSOLVED (DO)				7.9			MG/L	
5/31/2007	001A	OXYGEN, DISSOLVED (DO)				7.8			MG/L	
6/30/2007	001A	OXYGEN, DISSOLVED (DO)				7.2			MG/L	
7/31/2007	001A	OXYGEN, DISSOLVED (DO)				7.1			MG/L	
8/31/2007	001A	OXYGEN, DISSOLVED (DO)				6.9			MG/L	
9/30/2007	001A	OXYGEN, DISSOLVED (DO)				7.4			MG/L	
10/31/2007	001A	OXYGEN, DISSOLVED (DO)				7.7			MG/L	
11/30/2007	001A	OXYGEN, DISSOLVED (DO)				7.0			MG/L	
12/31/2007	001A	OXYGEN, DISSOLVED (DO)				8.1			MG/L	
1/31/2008	001A	OXYGEN, DISSOLVED (DO)				9.3			MG/L	
2/29/2008	001A	OXYGEN, DISSOLVED (DO)				9.1			MG/L	
10/31/2006	001A	PH				7.4		8	SU	
11/30/2006	001A	PH				7.2		8.0	SU	
12/31/2006	001A	PH				7.5		7.9	SU	
1/31/2007	001A	PH				7.1		7.8	SU	
2/28/2007	001A	PH				7.3		7.8	SU	
3/31/2007	001A	PH				7.2		7.8	SU	
4/30/2007	001A	PH				7.2		7.8	SU	
5/31/2007	001A	PH				7.5		8.0	SU	
6/30/2007	001A	PH				7.8		8.2	SU	
7/31/2007	001A	PH				7.1		8.2	SU	
8/31/2007	001A	PH				8.1		8.4	SU	
9/30/2007	001A	PH				7.6		8.4	SU	
10/31/2007	001A	PH				7.2		8.4	SU	
11/30/2007	001A	PH				7.0		8.1	SU	
12/31/2007	001A	PH				6.8		8.0	SU	
1/31/2008	001A	PH				6.7		8.1	SU	

PERMITTEE NAME **BELL COUNTY WCID NO. 1**
EPA ID **TX0102938**
TPDES ID **10351003**
SEG ID **1218**
OUTFALL NO **001A**

MONITORING END DATE	OUTFALL NO	PARAMETER	QUAN AVG	QUAN MAX	QUAN UNIT	CONC MIN	CONC AVG	CONC MAX	CONC UNIT	NO DISCHARGE INDICATOR
2/29/2008	001A	PH				7.1		8.2	SU	
10/31/2006	001A	SOLIDS, TOTAL SUSPENDED	30.7		LBS/DY		1.03	1.58	MG/L	
11/30/2006	001A	SOLIDS, TOTAL SUSPENDED	28.9		LBS/DY		1.09	2	MG/L	
12/31/2006	001A	SOLIDS, TOTAL SUSPENDED	33.4		LBS/DY		1.23	4.38	MG/L	
1/31/2007	001A	SOLIDS, TOTAL SUSPENDED	103		LBS/DY		2.09	8.96	MG/L	
2/28/2007	001A	SOLIDS, TOTAL SUSPENDED	31.3		LBS/DY		1.04	1.8	MG/L	
3/31/2007	001A	SOLIDS, TOTAL SUSPENDED	107		LBS/DY		1.86	12.1	MG/L	
4/30/2007	001A	SOLIDS, TOTAL SUSPENDED	48.7		LBS/DY		1.06	2.44	MG/L	
5/31/2007	001A	SOLIDS, TOTAL SUSPENDED	10509		LBS/DY		13.2	104	MG/L	
6/30/2007	001A	SOLIDS, TOTAL SUSPENDED	45		LBS/DY		1.25	3.02	MG/L	
7/31/2007	001A	SOLIDS, TOTAL SUSPENDED	32.6		LBS/DY		1.0	1.0	MG/L	
8/31/2007	001A	SOLIDS, TOTAL SUSPENDED	184		LBS/DY		1.02	1.66	MG/L	
9/30/2007	001A	SOLIDS, TOTAL SUSPENDED	16.3		LBS/DY		1.03	1.44	MG/L	
10/31/2007	001A	SOLIDS, TOTAL SUSPENDED	15.6		LBS/DY		1.12	4.2	MG/L	
11/30/2007	001A	SOLIDS, TOTAL SUSPENDED	14		LBS/DY		1.14	2.3	MG/L	
12/31/2007	001A	SOLIDS, TOTAL SUSPENDED	19		LBS/DY		1.41	12.1	MG/L	
1/31/2008	001A	SOLIDS, TOTAL SUSPENDED	12.8		LBS/DY		1.21	2.4	MG/L	
2/29/2008	001A	SOLIDS, TOTAL SUSPENDED	12.4		LBS/DY		1.05	1.4	MG/L	
10/31/2006	001A	NITROGEN, AMMONIA TOTAL (AS N)	46.8		LBS/DY		1.57	7.4	MG/L	
11/30/2006	001A	NITROGEN, AMMONIA TOTAL (AS N)	13.67		LBS/DY		.517	2.6	MG/L	
12/31/2006	001A	NITROGEN, AMMONIA TOTAL (AS N)	4.03		LBS/DY		.14	.95	MG/L	
1/31/2007	001A	NITROGEN, AMMONIA TOTAL (AS N)	4.62		LBS/DY		.11	.14	MG/L	
2/28/2007	001A	NITROGEN, AMMONIA TOTAL (AS N)	3.2		LBS/DY		.11	.25	MG/L	
3/31/2007	001A	NITROGEN, AMMONIA TOTAL (AS N)	8.39		LBS/DY		.16	.98	MG/L	
4/30/2007	001A	NITROGEN, AMMONIA TOTAL (AS N)	5.18		LBS/DY		.12	.18	MG/L	
5/31/2007	001A	NITROGEN, AMMONIA TOTAL (AS N)	6.56		LBS/DY		.12	.19	MG/L	
6/30/2007	001A	NITROGEN, AMMONIA TOTAL (AS N)	3.83		LBS/DY		.12	.32	MG/L	
7/31/2007	001A	NITROGEN, AMMONIA TOTAL (AS N)	3.64		LBS/DY		.11	.17	MG/L	
8/31/2007	001A	NITROGEN, AMMONIA TOTAL (AS N)	2.39		LBS/DY		.13	.2	MG/L	
9/30/2007	001A	NITROGEN, AMMONIA TOTAL (AS N)	2.13		LBS/DY		.13	.22	MG/L	
10/31/2007	001A	NITROGEN, AMMONIA TOTAL (AS N)	1.68		LBS/DY		.12	.21	MG/L	
11/30/2007	001A	NITROGEN, AMMONIA TOTAL (AS N)	1.46		LBS/DY		.12	.19	MG/L	
12/31/2007	001A	NITROGEN, AMMONIA TOTAL (AS N)	1.7		LBS/DY		.13	.2	MG/L	
1/31/2008	001A	NITROGEN, AMMONIA TOTAL (AS N)	1.9		LBS/DY		.18	.35	MG/L	
2/29/2008	001A	NITROGEN, AMMONIA TOTAL (AS N)	1.49		LBS/DY		.13	.45	MG/L	
10/31/2006	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	3.58	4.77	MGD					
11/30/2006	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	3.12	3.5	MGD					
12/31/2006	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	3.37	5.48	MGD					
1/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	5.31	8.88	MGD					
2/28/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	3.94	6.15	MGD					
3/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	5.39	10.1	MGD					
4/30/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	5.52	9.35	MGD					
5/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	6.45	14.12	MGD					
6/30/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	4.14	7.9	MGD					
7/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	3.91	8.48	MGD					
8/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	2.14	2.98	MGD					
9/30/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	1.96	2.55	MGD					
10/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	1.64	2.07	MGD					
11/30/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	1.52	2.05	MGD					
12/31/2007	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	1.64	3.58	MGD					
1/31/2008	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	1.31	2.6	MGD					
2/29/2008	001A	FLOW, IN CONDUIT OR THRU TREATMENT PLANT	1.43	3.26	MGD					
10/31/2006	001A	CHLORINE, TOTAL RESIDUAL						.09	MG/L	
11/30/2006	001A	CHLORINE, TOTAL RESIDUAL						.07	MG/L	
12/31/2006	001A	CHLORINE, TOTAL RESIDUAL						.09	MG/L	
1/31/2007	001A	CHLORINE, TOTAL RESIDUAL						.05	MG/L	
2/28/2007	001A	CHLORINE, TOTAL RESIDUAL						.04	MG/L	
3/31/2007	001A	CHLORINE, TOTAL RESIDUAL						.06	MG/L	
4/30/2007	001A	CHLORINE, TOTAL RESIDUAL						.04	MG/L	
5/31/2007	001A	CHLORINE, TOTAL RESIDUAL						.05	MG/L	
6/30/2007	001A	CHLORINE, TOTAL RESIDUAL						.08	MG/L	
7/31/2007	001A	CHLORINE, TOTAL RESIDUAL						.07	MG/L	
8/31/2007	001A	CHLORINE, TOTAL RESIDUAL						.08	MG/L	
9/30/2007	001A	CHLORINE, TOTAL RESIDUAL						.08	MG/L	
10/31/2007	001A	CHLORINE, TOTAL RESIDUAL						.04	MG/L	
11/30/2007	001A	CHLORINE, TOTAL RESIDUAL						.07	MG/L	
12/31/2007	001A	CHLORINE, TOTAL RESIDUAL						.08	MG/L	

PERMITTEE NAME **BELL COUNTY WCID NO. 1**
EPA ID **TX0102938**
TPDES ID **10351003**
SEG ID **1218**
OUTFALL NO **001A**

MONITORING END DATE	OUTFALL NO	PARAMETER	QUAN AVG	QUAN MAX	QUAN UNIT	CONC MIN	CONC AVG	CONC MAX	CONC UNIT	NO DISCHARGE INDICATOR
1/31/2008	001A	CHLORINE, TOTAL RESIDUAL						.07	MG/L	
2/29/2008	001A	CHLORINE, TOTAL RESIDUAL						.07	MG/L	
10/31/2006	001A	CHLORINE, TOTAL RESIDUAL				1.02			MG/L	
11/30/2006	001A	CHLORINE, TOTAL RESIDUAL				.83			MG/L	
12/31/2006	001A	CHLORINE, TOTAL RESIDUAL				.88			MG/L	
1/31/2007	001A	CHLORINE, TOTAL RESIDUAL				.69			MG/L	
2/28/2007	001A	CHLORINE, TOTAL RESIDUAL				.54			MG/L	
3/31/2007	001A	CHLORINE, TOTAL RESIDUAL				.79			MG/L	
4/30/2007	001A	CHLORINE, TOTAL RESIDUAL				.51			MG/L	
5/31/2007	001A	CHLORINE, TOTAL RESIDUAL				1.			MG/L	
6/30/2007	001A	CHLORINE, TOTAL RESIDUAL				.99			MG/L	
7/31/2007	001A	CHLORINE, TOTAL RESIDUAL				.77			MG/L	
8/31/2007	001A	CHLORINE, TOTAL RESIDUAL				.84			MG/L	
9/30/2007	001A	CHLORINE, TOTAL RESIDUAL				.75			MG/L	
10/31/2007	001A	CHLORINE, TOTAL RESIDUAL				1.03			MG/L	
11/30/2007	001A	CHLORINE, TOTAL RESIDUAL				1.13			MG/L	
12/31/2007	001A	CHLORINE, TOTAL RESIDUAL				1.0			MG/L	
1/31/2008	001A	CHLORINE, TOTAL RESIDUAL				1.0			MG/L	
2/29/2008	001A	CHLORINE, TOTAL RESIDUAL				1.01			MG/L	
10/31/2006	001A	BOD, CARBONACEOUS 05 DAY, 20C	65.6		LBS/DY		2.2	4.32	MG/L	
11/30/2006	001A	BOD, CARBONACEOUS 05 DAY, 20C	57.2		LBS/DY		2.17	3.05	MG/L	
12/31/2006	001A	BOD, CARBONACEOUS 05 DAY, 20C	59		LBS/DY		2.1	2.3	MG/L	
1/31/2007	001A	BOD, CARBONACEOUS 05 DAY, 20C	95		LBS/DY		2.18	4.07	MG/L	
2/28/2007	001A	BOD, CARBONACEOUS 05 DAY, 20C	61.4		LBS/DY		2.07	2.07	MG/L	
3/31/2007	001A	BOD, CARBONACEOUS 05 DAY, 20C	102		LBS/DY		2.17	5.3	MG/L	
4/30/2007	001A	BOD, CARBONACEOUS 05 DAY, 20C	92		LBS/DY		2.07	2.07	MG/L	
5/31/2007	001A	BOD, CARBONACEOUS 05 DAY, 20C	158		LBS/DY		2.54	6.46	MG/L	
6/30/2007	001A	BOD, CARBONACEOUS 05 DAY, 20C	69		LBS/DY		2.07	2.07	MG/L	
7/31/2007	001A	BOD, CARBONACEOUS 05 DAY, 20C	.66		LBS/DY		2.07	2.07	MG/L	
8/31/2007	001A	BOD, CARBONACEOUS 05 DAY, 20C	37.3		LBS/DY		2.09	2.71	MG/L	
9/30/2007	001A	BOD, CARBONACEOUS 05 DAY, 20C	32.9		LBS/DY		2.08	2.48	MG/L	
10/31/2007	001A	BOD, CARBONACEOUS 05 DAY, 20C	28.4		LBS/DY		2.07	2.19	MG/L	
11/30/2007	001A	BOD, CARBONACEOUS 05 DAY, 20C	25		LBS/DY		2.07	2.07	MG/L	
12/31/2007	001A	BOD, CARBONACEOUS 05 DAY, 20C	28.4		LBS/DY		2.07	2.07	MG/L	
1/31/2008	001A	BOD, CARBONACEOUS 05 DAY, 20C	23		LBS/DY		2.07	2.25	MG/L	
2/29/2008	001A	BOD, CARBONACEOUS 05 DAY, 20C	23		LBS/DY		2.1	2.33	MG/L	

Appendix C: Monthly Bacteria Monitoring Results

October 2006 – February 2008

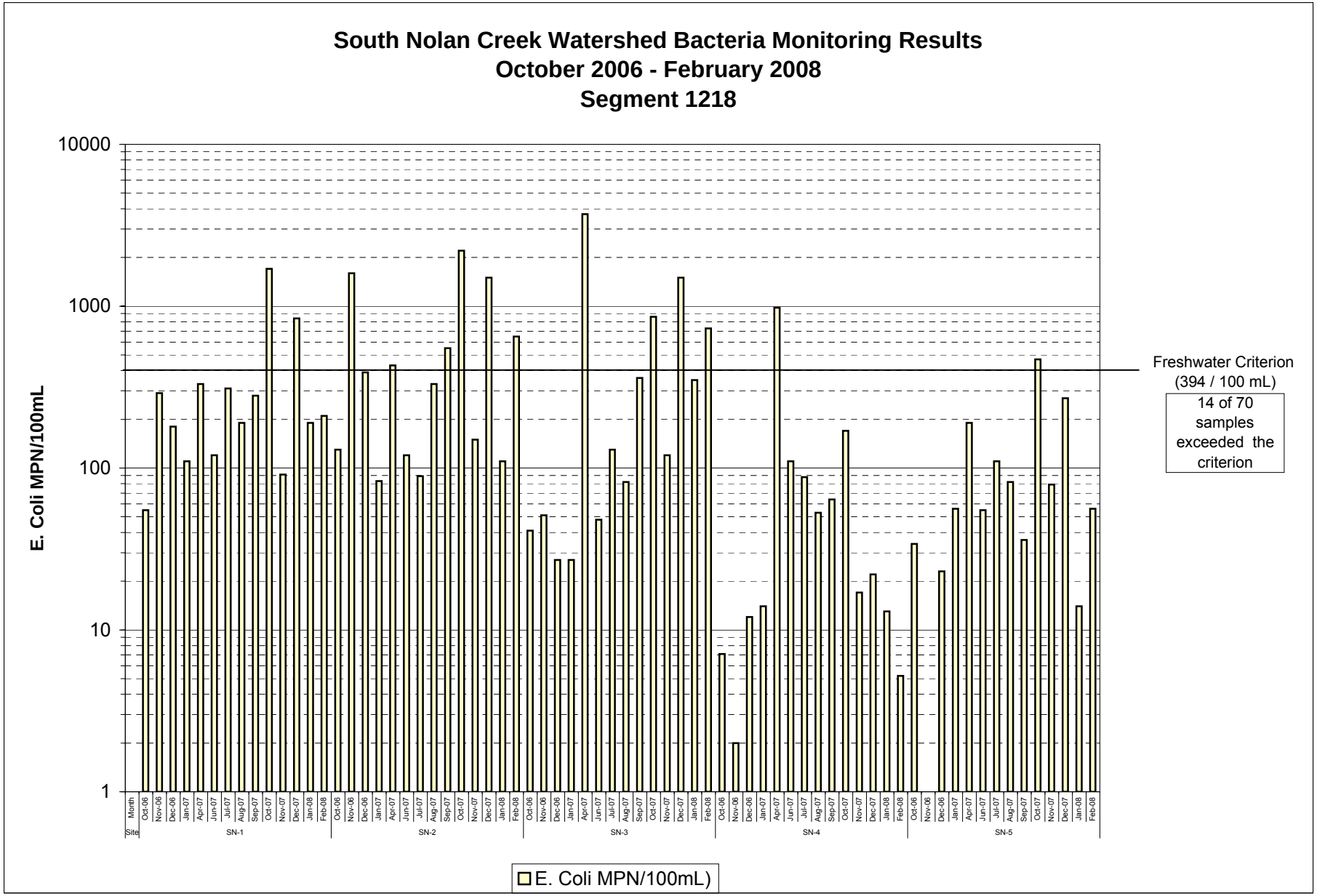
Table C-1. Water Quality Monitoring Parameters

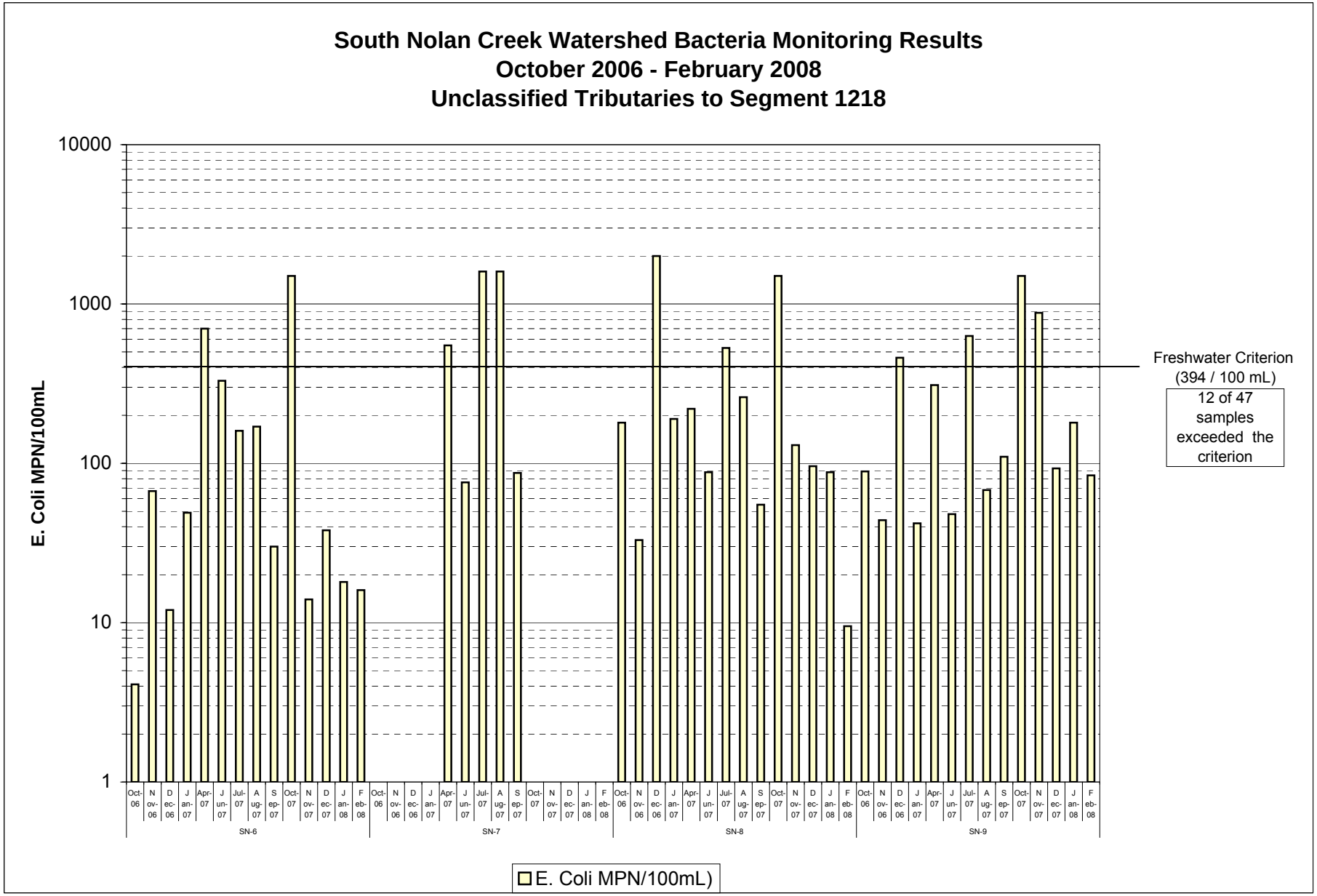
Water Quality Monitoring Parameters

Category	Parameter Code	Parameter Description	Abbreviation	Units of Measurement	Method	Monitoring Component: Ambient: Semi-Annual	Monitoring Component: Ambient: Monthly	Monitoring Component: Storm: Flow Weighted Composite	Monitoring Component: Storm: Instantaneous Grab
Field	00010	Water Temperature	Temp	º C	EPA 170.1, TCEQ SOP	X			
	00300	Dissolved Oxygen	DO	mg/L	EPA 360.1, TCEQ SOP	X			
	00400	pH	pH	S.U.	EPA 150.1, TCEQ SOP	X			
	00094	Specific Conductance, Field	Cond	µmhos/cm at 25ºC	EPA 120.1, TCEQ SOP	X			
	00061	Instantaneous Stream Flow	Flow	cfs	TCEQ SOP	X			
	89835	Flow Method: 1=Gage 2=Electric 3=Mechanical 4=Weir/Flume 5=Doppler	FMeth	Code	TCEQ SOP	X			
	72053	Days Since Precipitation Event	DSLP	Days	TCEQ SOP	X			
	01351	Flow Severity: 1=No Flow 2=Low 3=Normal 4=Flood 5=High 6=Dry	Flowsev	Code	TCEQ SOP	X			
Nutrients	00608	Ammonia Nitrogen, Dissolved	NH3-N	mg/L as N	EPA 350.1	X		X	
	00631	Nitrite plus Nitrate Nitrogen, Dissolved	NO2+NO3-N	mg/L as N	EPA 353.2	X		X	
	00625	Total Kjeldahl Nitrogen	TKN	mg/L as N	EPA 351.2, modified	X		X	
	00671	Orthophosphate Phosphorus, Dissolved, Field Filtered<15 Min.	OPO4-P	mg/L as P	EPA 365.2	X			
	70507	Orthophosphate Phosphorus, Dissolved, Filter >15 Min.	OPO4-P	mg/L as P	EPA 365.2			X	
	00665	Total Phosphorus	TP	mg/L as P	EPA 365.4, modified	X		X	
Metals	01000	Arsenic, Dissolved	As	µg/L as As	EPA 200.8	X			X
	01005	Barium, Dissolved	Ba	µg/L as Ba	EPA 200.8	X			X
	01025	Cadmium, Dissolved	Cd	µg/L as Cd	EPA 200.8	X			X
	01034	Chromium, Total	Cr	µg/L as Cr	EPA 200.8	X			X
	01040	Copper, Dissolved	Cu	µg/L as Cu	EPA 200.8	X			X
	01049	Lead, Dissolved	Pb	µg/L as Pb	EPA 200.8	X			X
	01055	Manganese, Total	Mn	µg/L as Mn	EPA 200.8	X			X
	01065	Nickel, Dissolved	Ni	µg/L as Ni	EPA 200.8	X			X
	01147	Selenium, Total	Se	µg/L as Se	EPA 200.8	X			X
	01075	Silver, Dissolved	Ag	µg/L as Ag	EPA 200.8	X			X
	01090	Zinc, Dissolved	Zn	µg/L as Zn	EPA 200.8	X			X
Bacteria	31699	E. coli, colilert, IDEXX Method	E. coli	MPN/100 ml	SM 9223-B		X		
Organics	00310	Biochemical Oxygen Demand (5 DAY - 20º C)	BOD5	mg/L	EPA 405.1	X		X	
Sediment	00530	Total Nonfiltrable Residue (Total Suspended Solids)	TSS	mg/L	EPA 160.2	X		X	
Oil/Grease	00552	Oil and Grease, Total recoverable	O&G	mg/L	EPA 1664	X			X

Table C-2. Monitoring Site Descriptions

TCEQ Site ID	Killeen Site ID	Short Description	Long Description	Lat	Long
18826	SN-1	South Nolan Creek at Ann Boulevard	South Nolan Creek at Ann Blvd 52 meters downstream of Caprice Ditch confluence	31.095175	-97.662635
11913	SN-2	South Nolan Creek at Roy Reynolds Drive	South Nolan Creek at Roy Reynolds Drive 355 meters downstream of Little Nolan Creek confluence	31.099382	-97.671748
18827	SN-3	South Nolan Creek at Twin Creek Drive	South Nolan Creek at Twin Creek Drive 200 meters downstream of Long Branch confluence	31.103470	-97.687853
18828	SN-4	South Nolan Creek at 38th Street	South Nolan Creek at 38th Street 64 meters downstream of Bell Co. WCID WWTP outfall	31.108091	-97.702156
15271	SN-5	South Nolan Creek at SH 195	South Nolan Creek at SH 195/South Fort Hood Street, 113 meters downstream of confluence with unnamed tributary draining Fort Hood	31.119325	-97.743390
18829	SN-6	South Nolan Creek at Watercrest Road	South Nolan Creek at Watercrest Road 13 meters downstream of Rain Forest Creek confluence	31.109053	-97.773182
18830	SN-7	Bermuda Ditch at Central Texas Expressway	Bermuda Ditch immediately upstream of Central Texas Expressway	31.112101	-97.758994
18833	SN-8	Little Nolan Creek Tributary at Central Texas Expressway	Unnamed Tributary of Little Nolan Creek immediately upstream of Central Texas Expressway	31.089065	-97.717915
18834	SN-9	Little Nolan Creek at Central Texas Expressway	Little Nolan Creek immediately upstream of Central Texas Expressway	31.084233	-97.707615


South Nolan Creek Watershed Bacteria Monitoring Results
October 2006 - February 2008
Segment 1218
E. Coli MPN/100mL
10000
1000
100
10
1
Freshwater Criterion
(394 / 100 mL)
14 of 70
samples
exceeded the
criterion
Site
Month
SN-1
SN-2
SN-3
SN-4
SN-5
E. Coli MPN/100mL)


South Nolan Creek Watershed Bacteria Monitoring Results
October 2006 - February 2008
Unclassified Tributaries to Segment 1218
E. Coli MPN/100mL
10000
1000
100
10
1
Freshwater Criterion
(394 / 100 mL)
12 of 47
samples
exceeded the
criterion
Oct-06
Nov-06
Dec-06
Jan-07
Apr-07
Jun-07
Jul-07
Aug-07
Sep-07
Oct-07
Nov-07
Dec-07
Jan-08
Feb-08
SN-6
SN-7
SN-8
SN-9
E. Coli MPN/100mL)

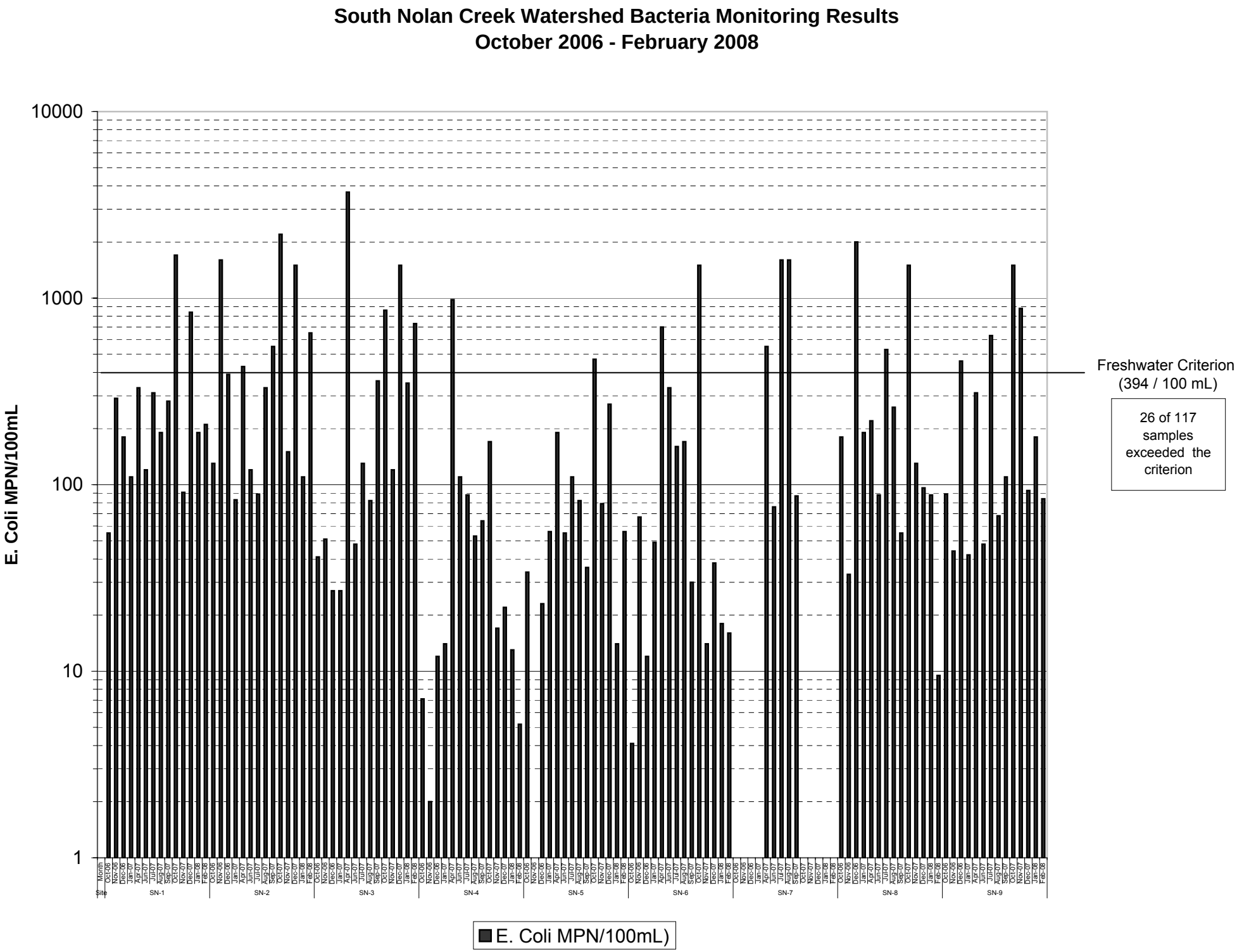


Figure C-3. Bacteria Monitoring Results – All Sites

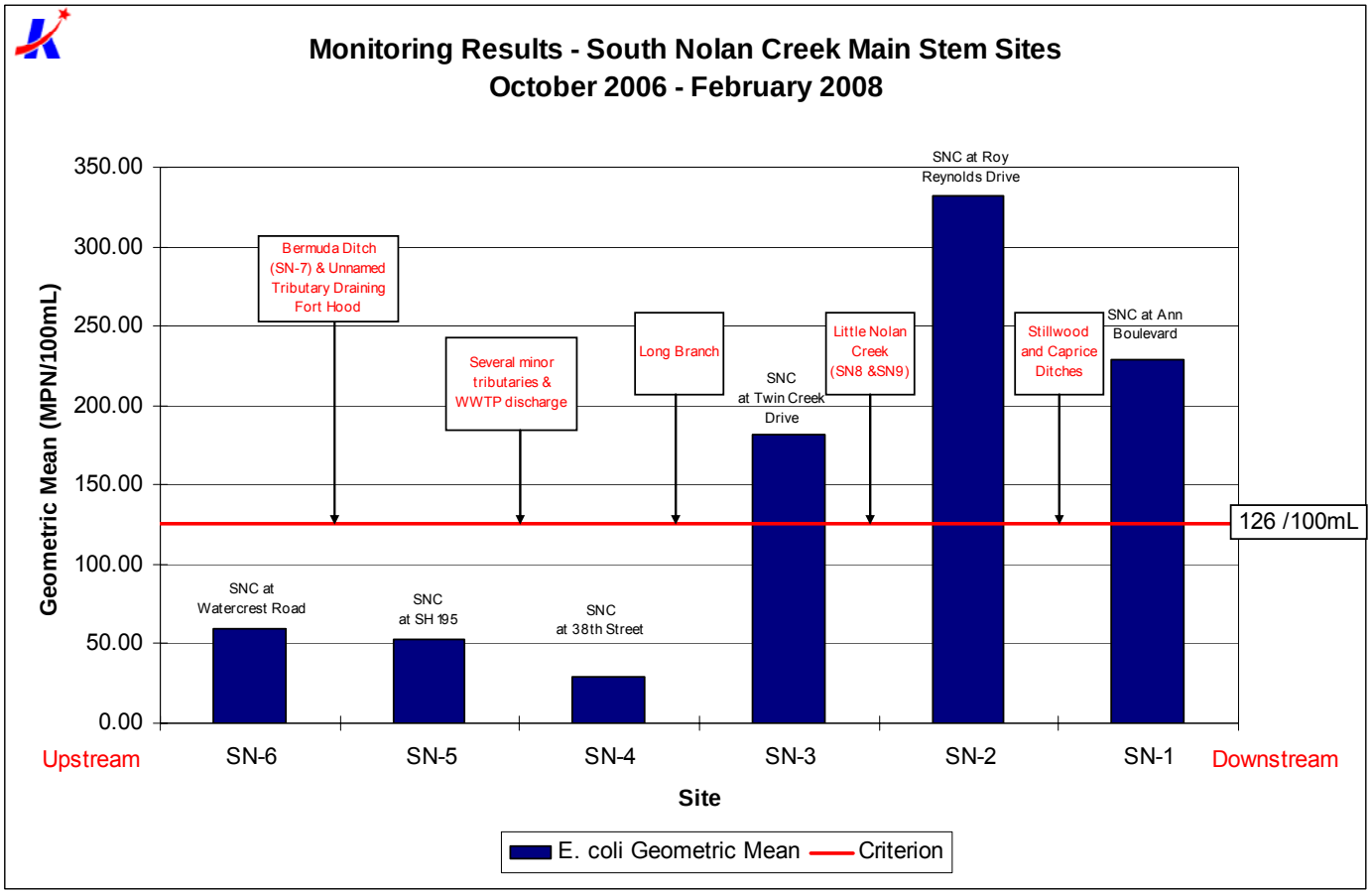


Figure C-4. Geometric Mean E. coli Concentrations – Main Stem Sites

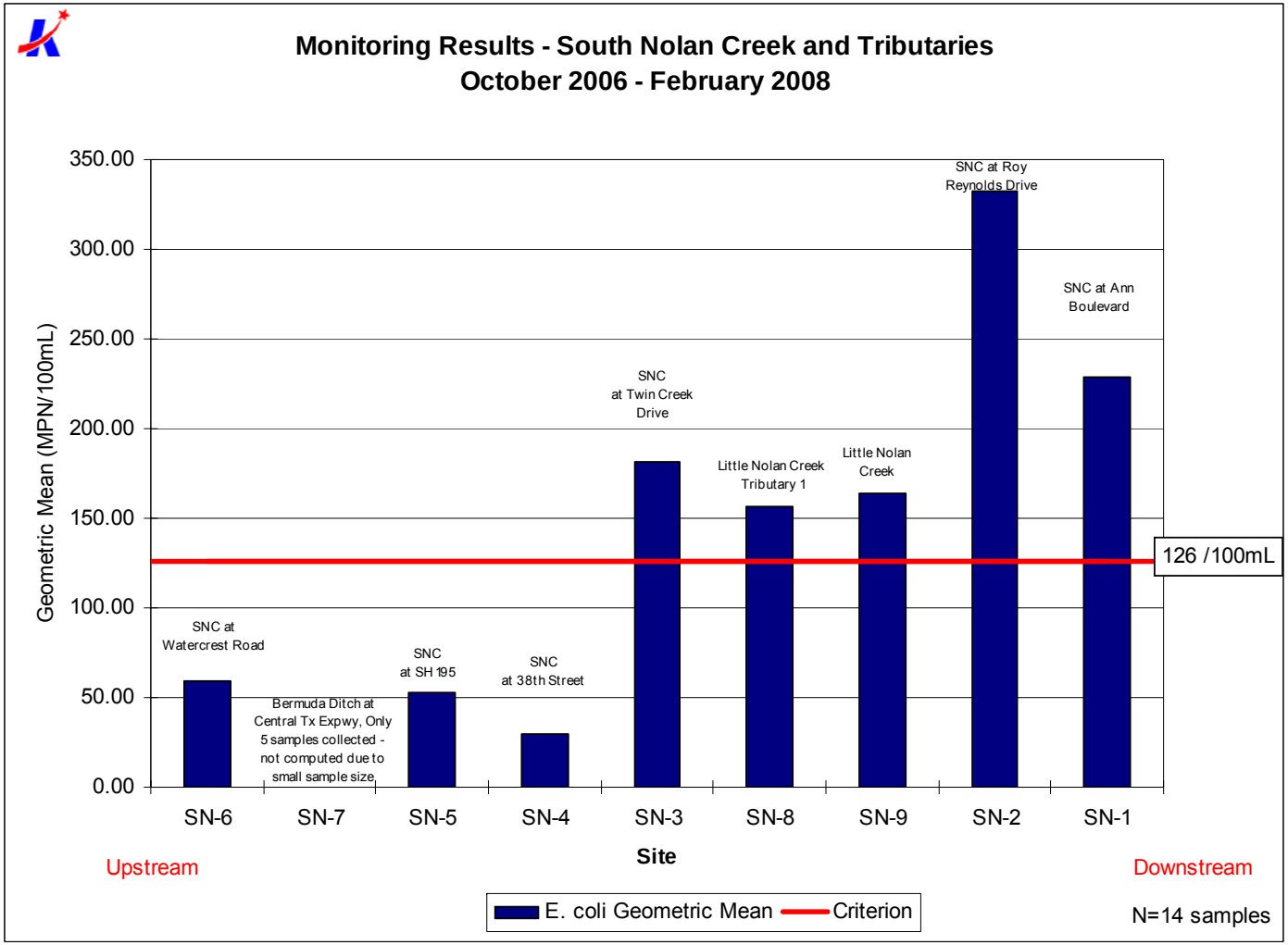


Figure C- 5. Geometric Mean E. coli Concentrations – All Sites

Appendix D: Ambient Monitoring Results

Semi-Annual Monitoring of Five Main Stem South Nolan Creek Sites

October 2006 – February 2008

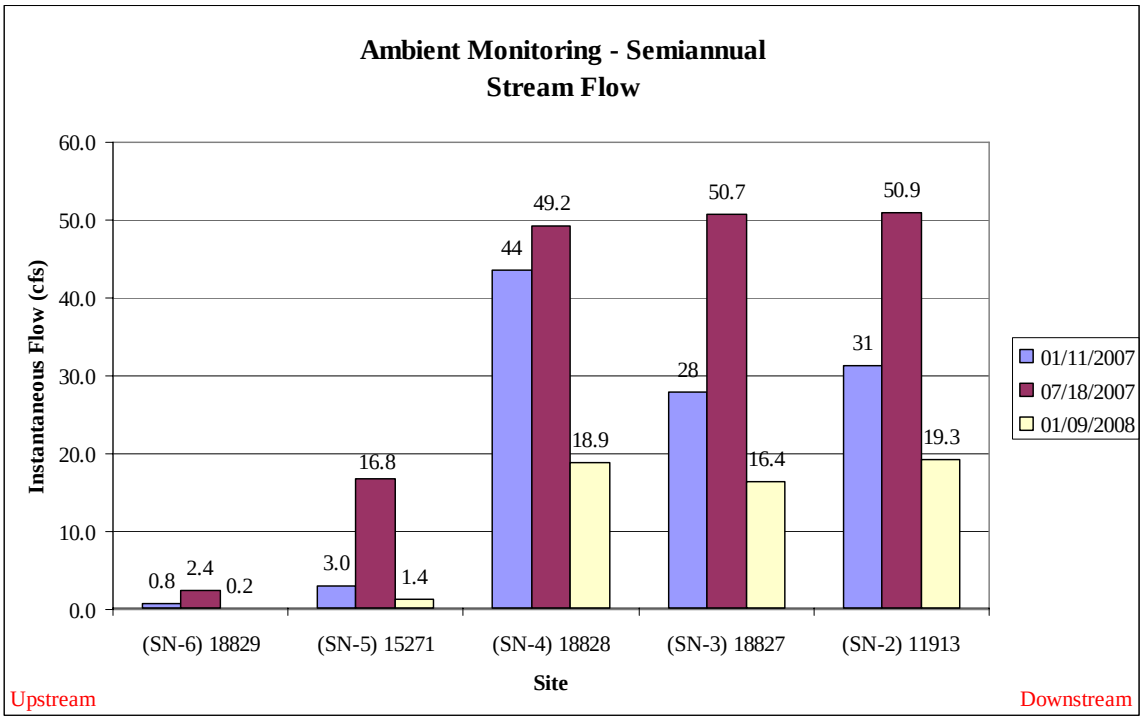


Figure D-1. Ambient Monitoring Results - Flow

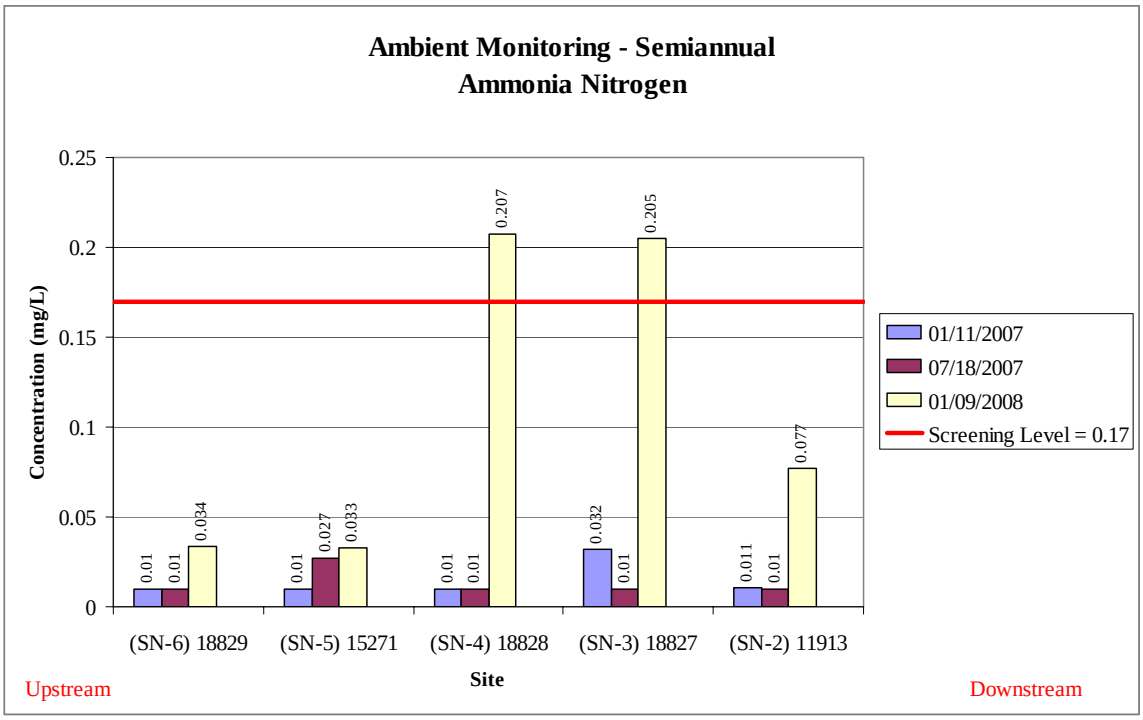


Figure D-2. Ambient Monitoring Results – Ammonia Nitrogen

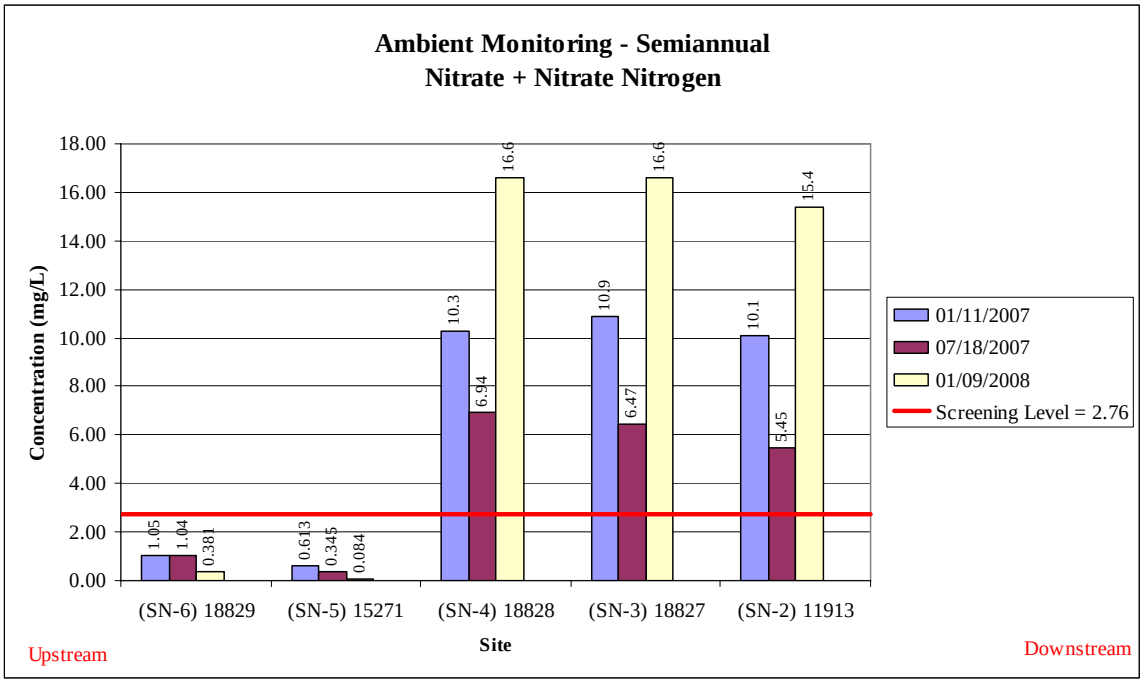


Figure D-3. Ambient Monitoring Results – Nitrate + Nitrite Nitrogen

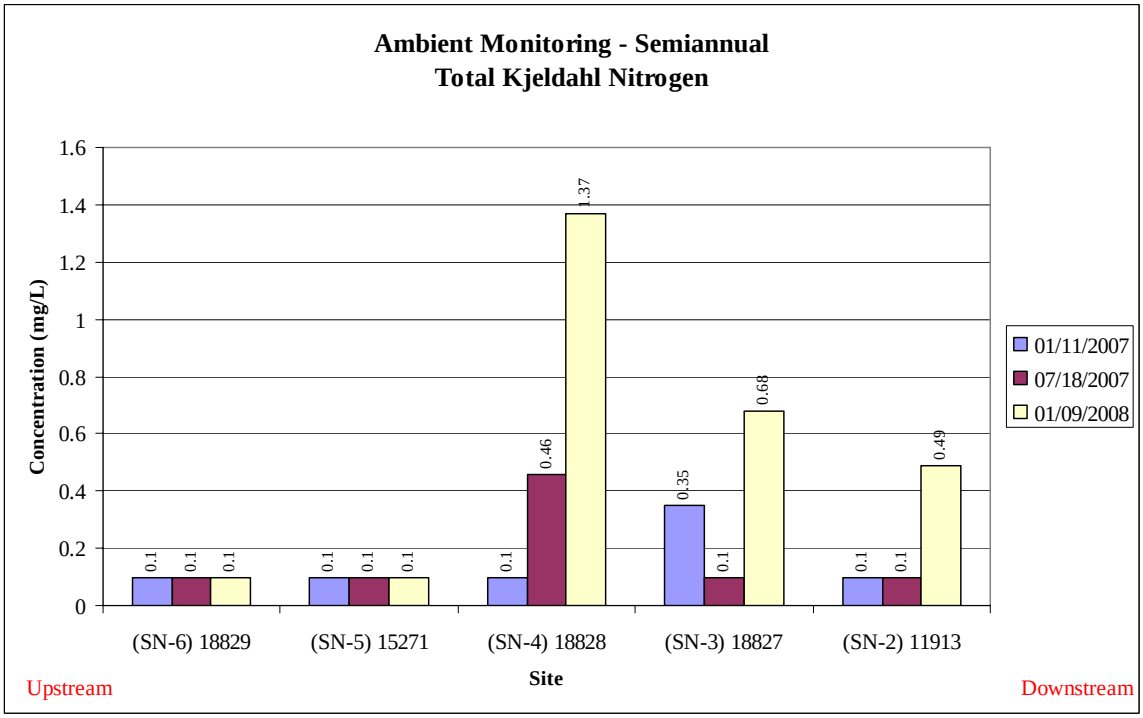


Figure D-4. Ambient Monitoring Results – Total Kjeldahl Nitrogen

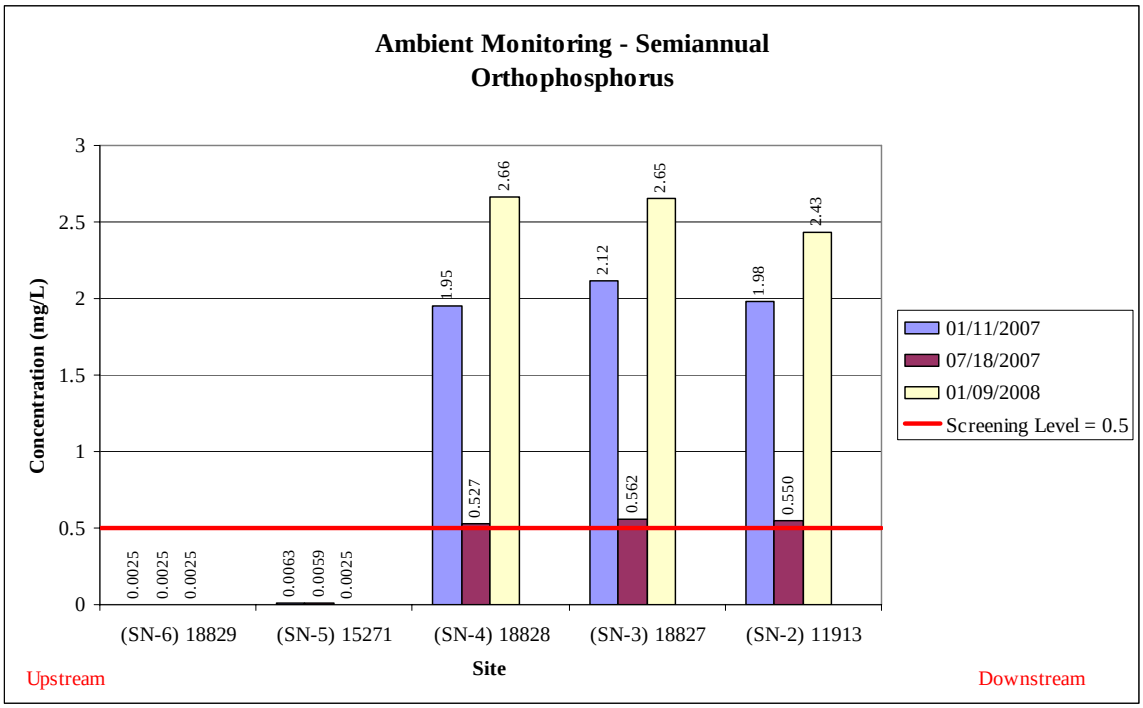


Figure D-5. Ambient Monitoring Results – Orthophosphate Phosphorus

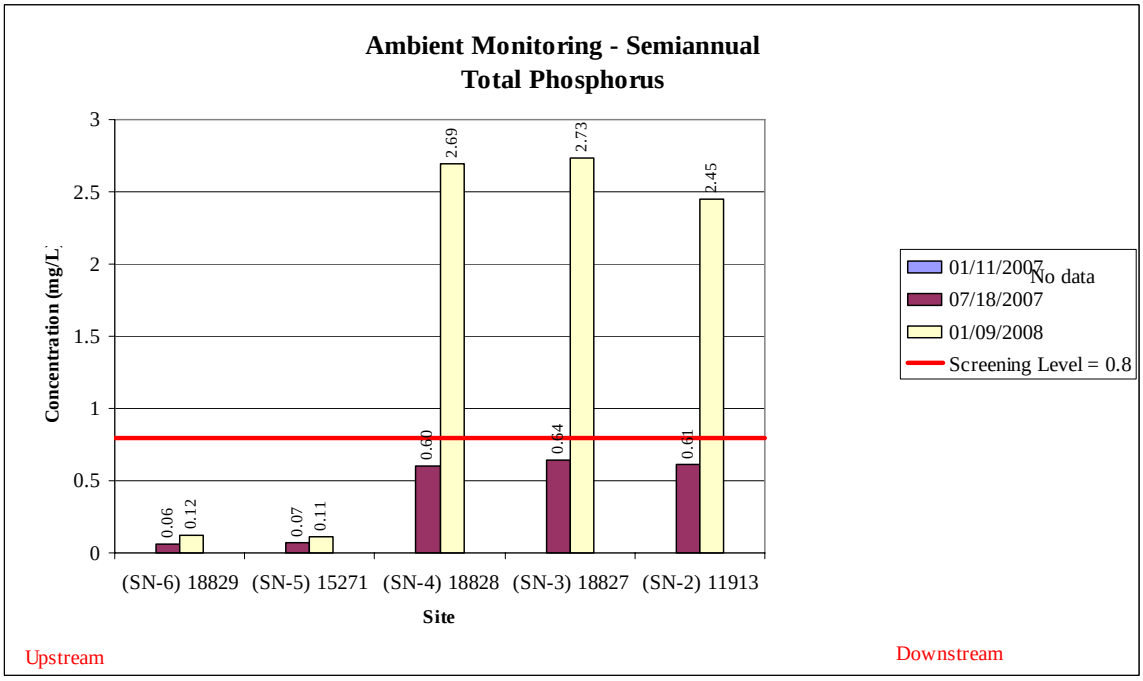


Figure D-6. Ambient Monitoring Results – Total Phosphorus

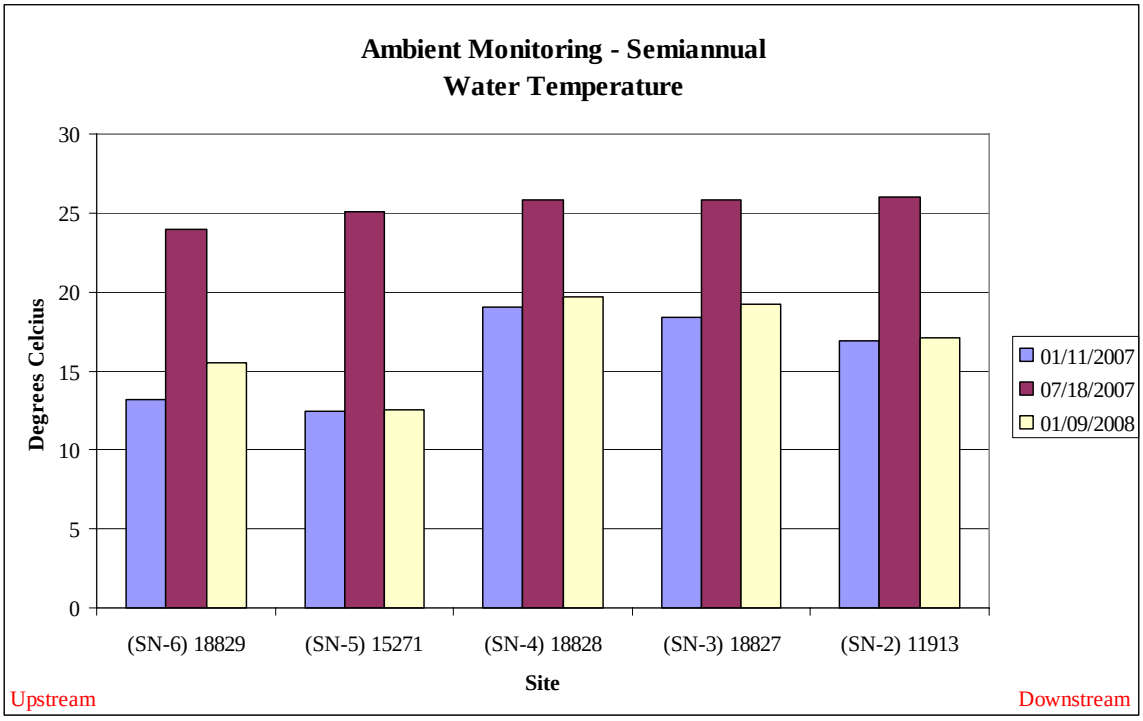


Figure D-7. Ambient Monitoring Results – Water Temperature

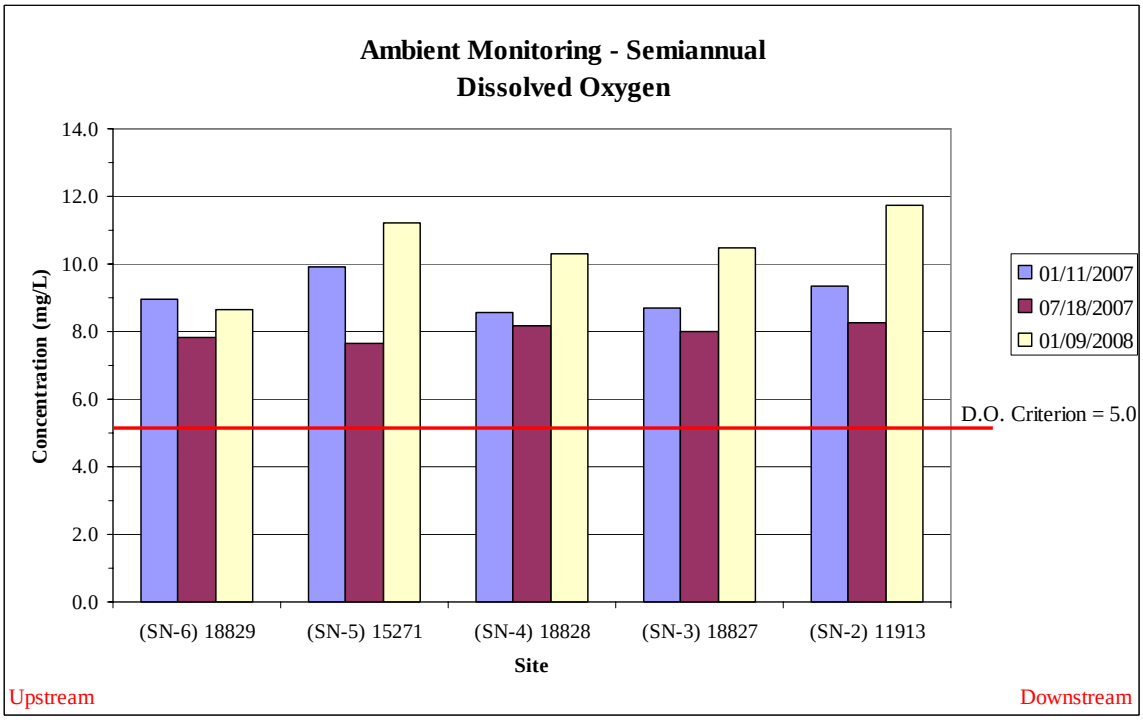


Figure D-8. Ambient Monitoring Results – Dissolved Oxygen

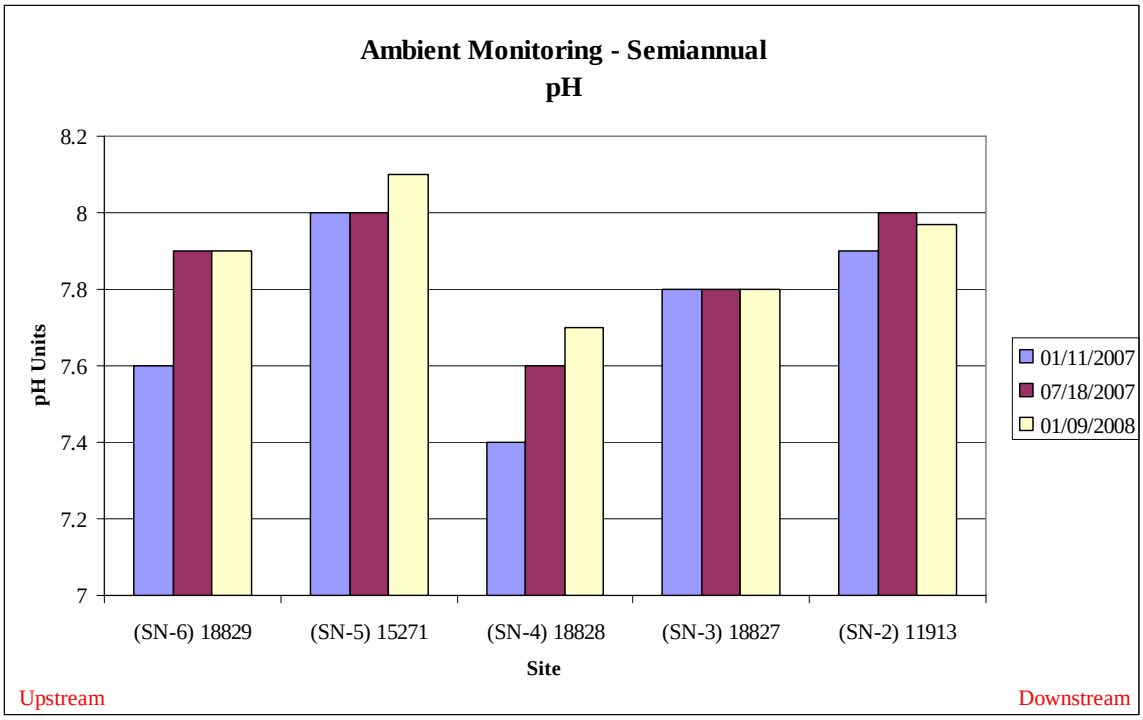


Figure D-9. Ambient Monitoring Results - pH

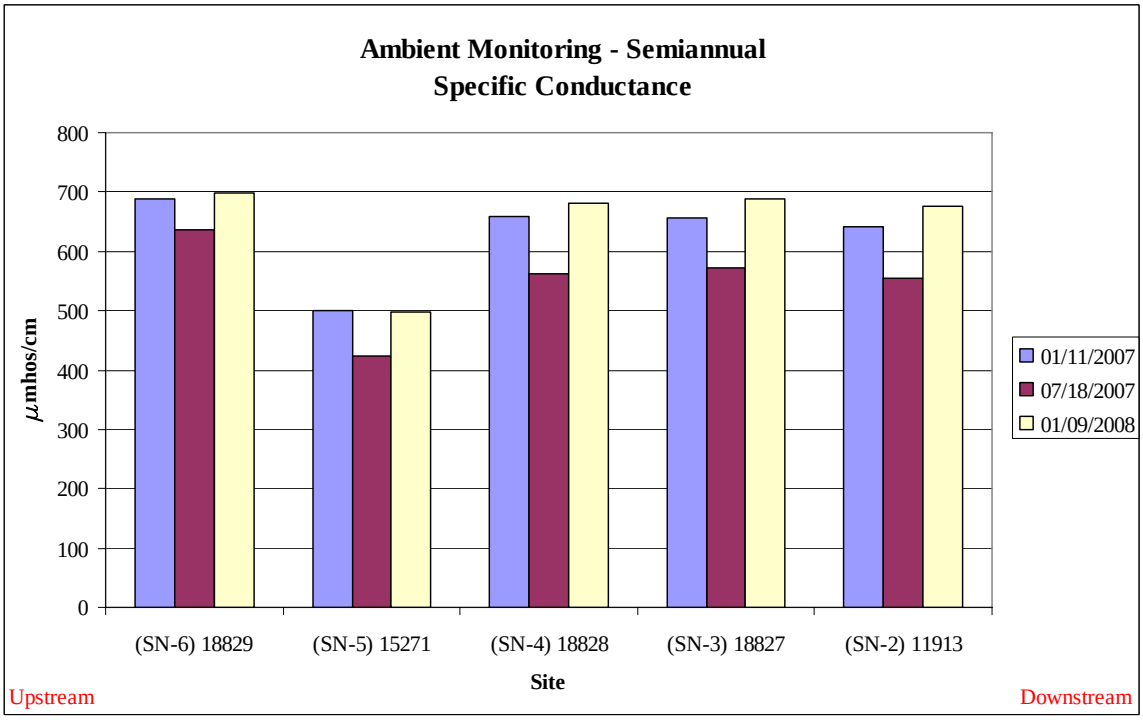


Figure D-10. Ambient Monitoring Results – Specific Conductance

Appendix E: Storm Event Monitoring

At SN-2 South Nolan Creek at Roy Reynolds Drive

October 2006 – February 2008

Table E-1. South Nolan Creek Storm Events

South Nolan Creek Storm Events

Killeen Site ID	TCEQ Site ID	Storm Event	Start Date	Start Time	End Date	End Time	Duration (hrs)	Number of Samples	Average Flow (cfs)
SN-2	11913	1	10/10/2006	07:23	10/11/2006	05:23	22.0	14	28.59
SN-2	11913	2	10/16/2006	07:40	10/17/2006	08:08	24.5	15	51.85
SN-2	11913	3	04/17/2007	19:20	04/18/2007	10:45	15.4	10	38.90
SN-2	11913	4	04/30/2007	06:25	05/01/2007	05:50	23.4	14	40.75
SN-2	11913	5	05/01/2007	05:55	05/02/2007	10:00	28.1	14	100.52
SN-2	11913	6	06/14/2007	07:20	06/14/2007	14:45	7.4	6	56.08
SN-2	11913	7	06/14/2007	14:50	06/15/2007	09:40	18.8	7	53.72
SN-2	11913	8	09/04/2007	18:00	09/05/2007	15:25	21.4	13	50.73
SN-2	11913	9	12/15/2007	03:35	12/15/2007	13:40	10.1	7	29.32

Table E-2. South Nolan Creek Storm Event Concentrations

South Nolan Creek Storm Event Concentrations

	Flow Weighted Concentrations (Event Mean Concentrations)							Instantaneous Conc.
Event #	TSS	BOD-5	Ammonia-N	Nitrate+ Nitrite-N	Total Kjeldahl-N	Total Phosphorus	Orthophosphorus	Oil & Grease
	00530	00310	00608	00631	00625	00665	70507	00552
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
1	349	8.2	0.04	1.74	1.41	0.67	0.361	6.5
2	394	5.5	0.046	1.00	1.47	0.57	0.290	7.3
3	115	8.1	<0.02	3.10	0.21		0.296	<5
4	200	11.4	0.112	2.65	--	0.68	0.415	<5
5	750	5.1	0.087	1.79	--	0.55	0.296	25.4
6	120	13.7	0.035	1.55	1.14	0.44	0.122	--
7	319	7.3	<0.02	1.53	1.68	0.43	0.144	--
8	168	5.3	0.020	1.31	1.21	0.43	0.208	<5
9	165	12.2	0.211	2.81	1.58	0.62	0.41	<5
N	9	9	9	9	7	8	9	7
Min of EMCs	115	5.10	0.010	1.00	0.21	0.43	0.122	2.5
Max of EMCs	750	13.70	0.211	3.10	1.68	0.68	0.415	25.4
Mean of EMCs	287	8.53	0.063	1.94	1.24	0.55	0.282	7.0
Median of EMCs	200	8.1	0.04	1.74	1.41	0.56	0.296	2.5

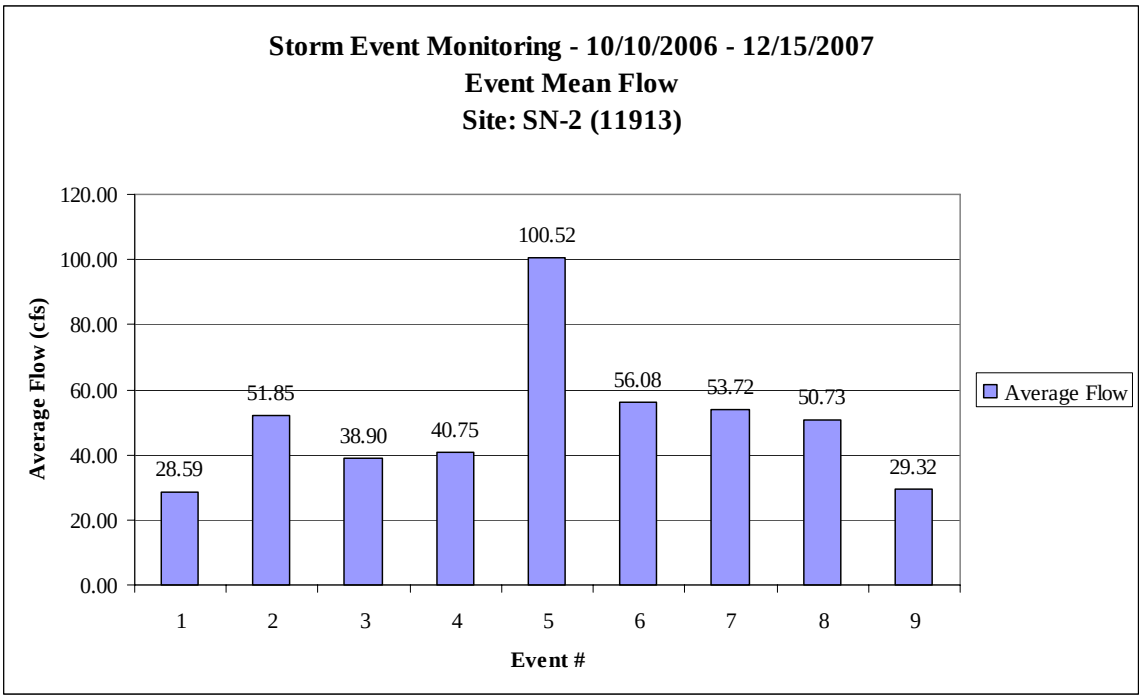


Figure E-1. Storm Event Monitoring Results – Average Flow

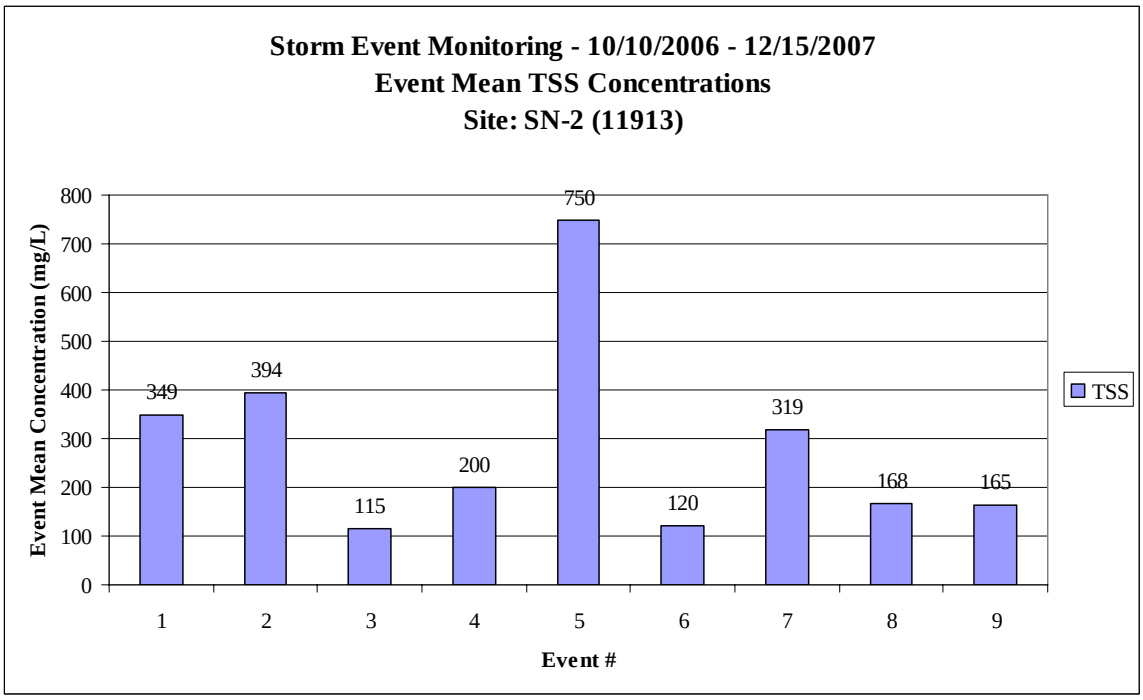


Figure E-2. Storm Event Monitoring Results – TSS EMC

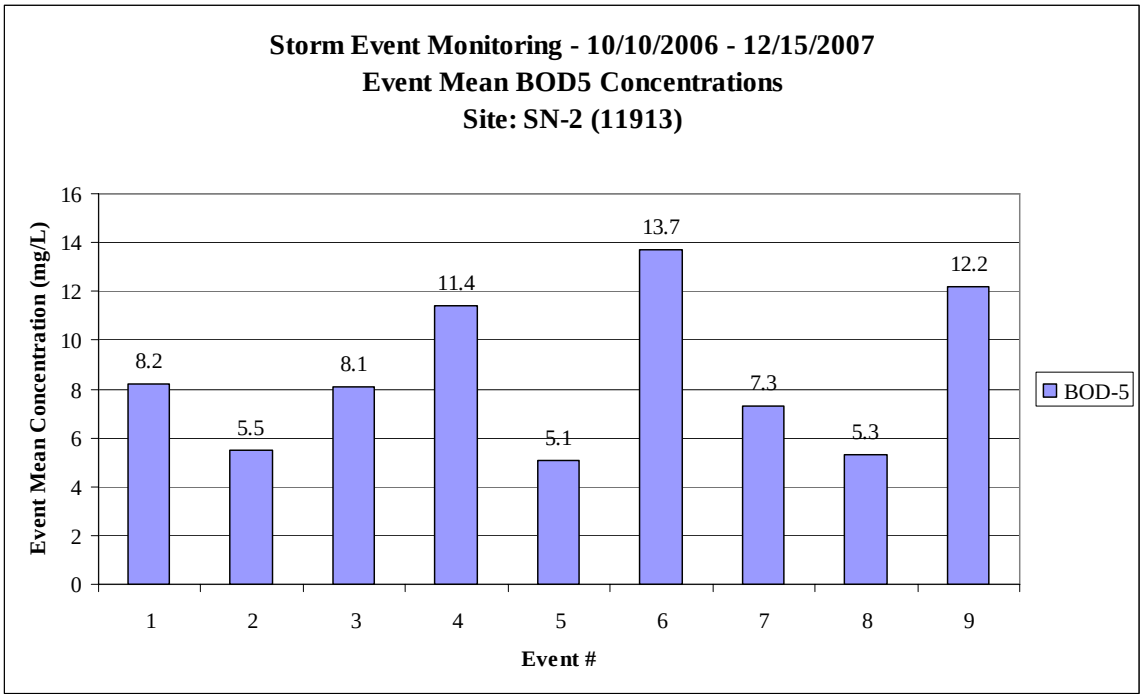


Figure E-3. Storm Event Monitoring Results – BOD5 EMC

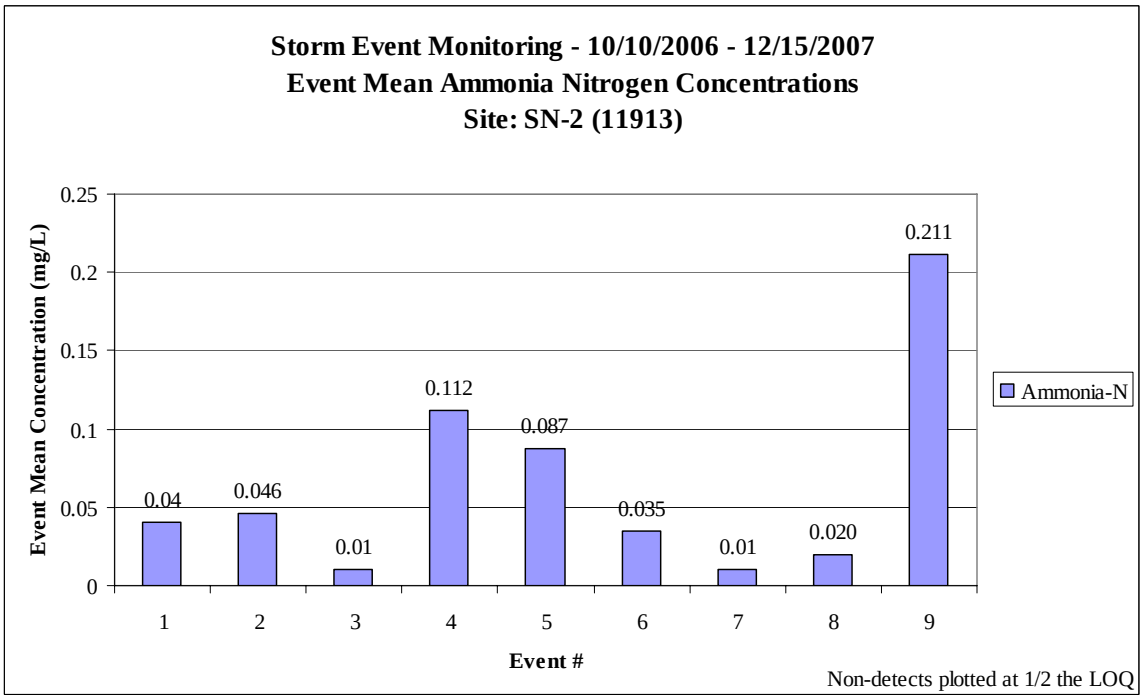


Figure E-4. Storm Event Monitoring Results – Ammonia Nitrogen EMC

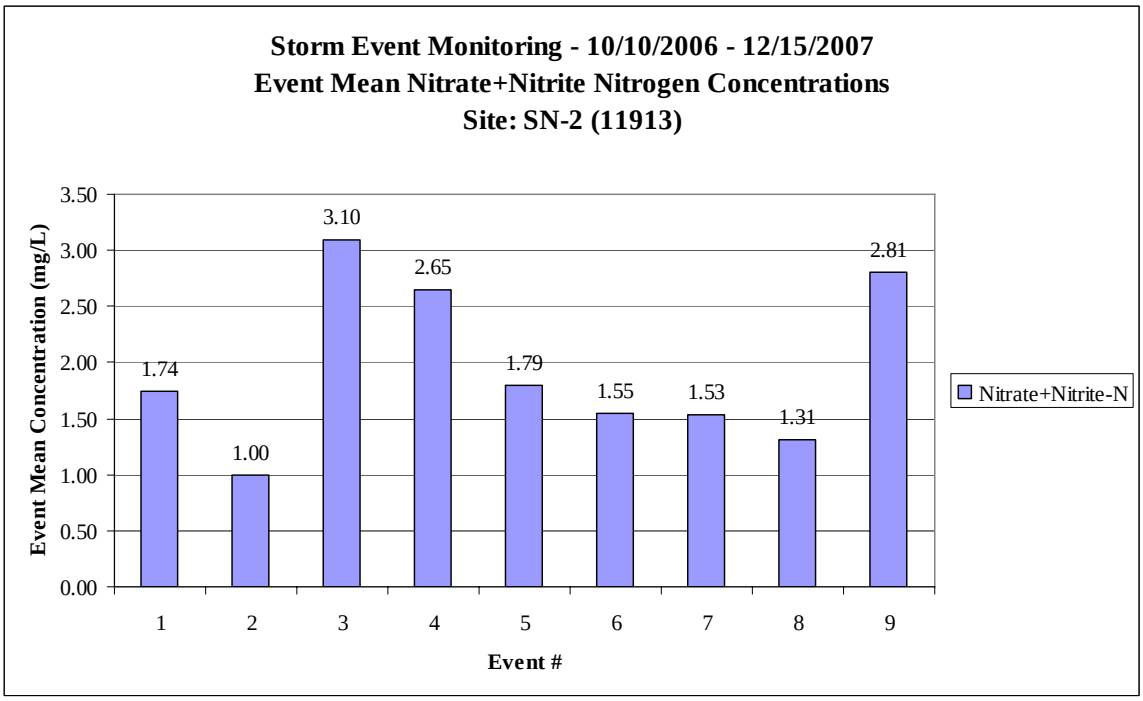


Figure E-5. Storm Event Monitoring Results – Nitrate + Nitrite Nitrogen EMC

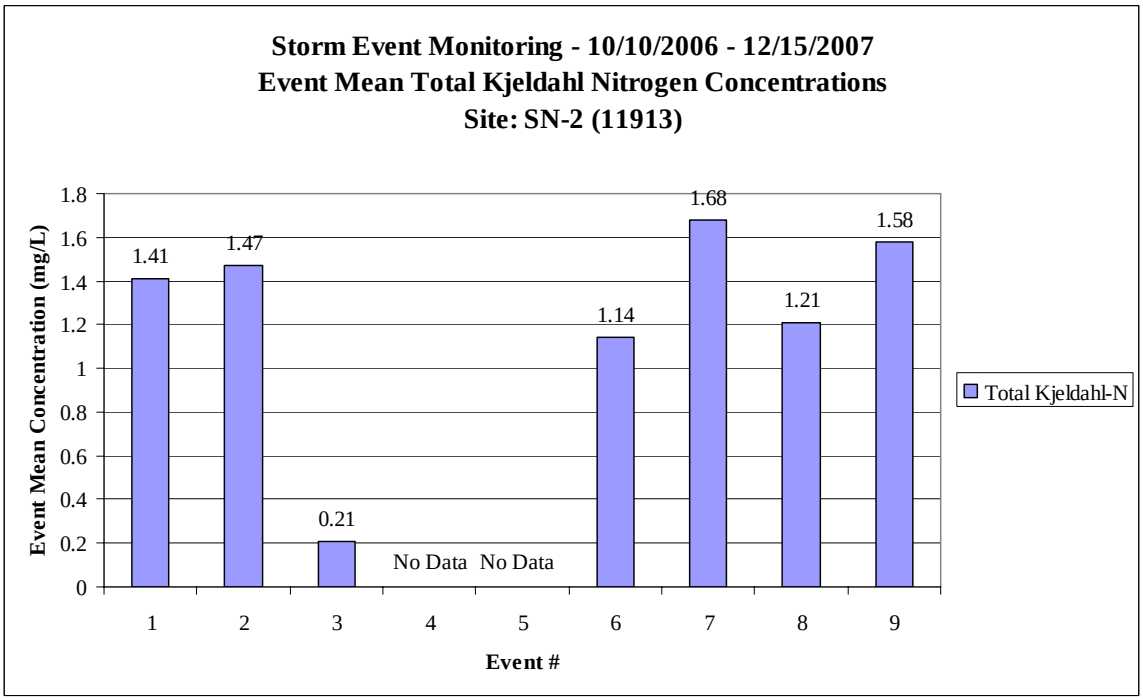


Figure E-6. Storm Event Monitoring Results – Total Kjeldahl Nitrogen EMC

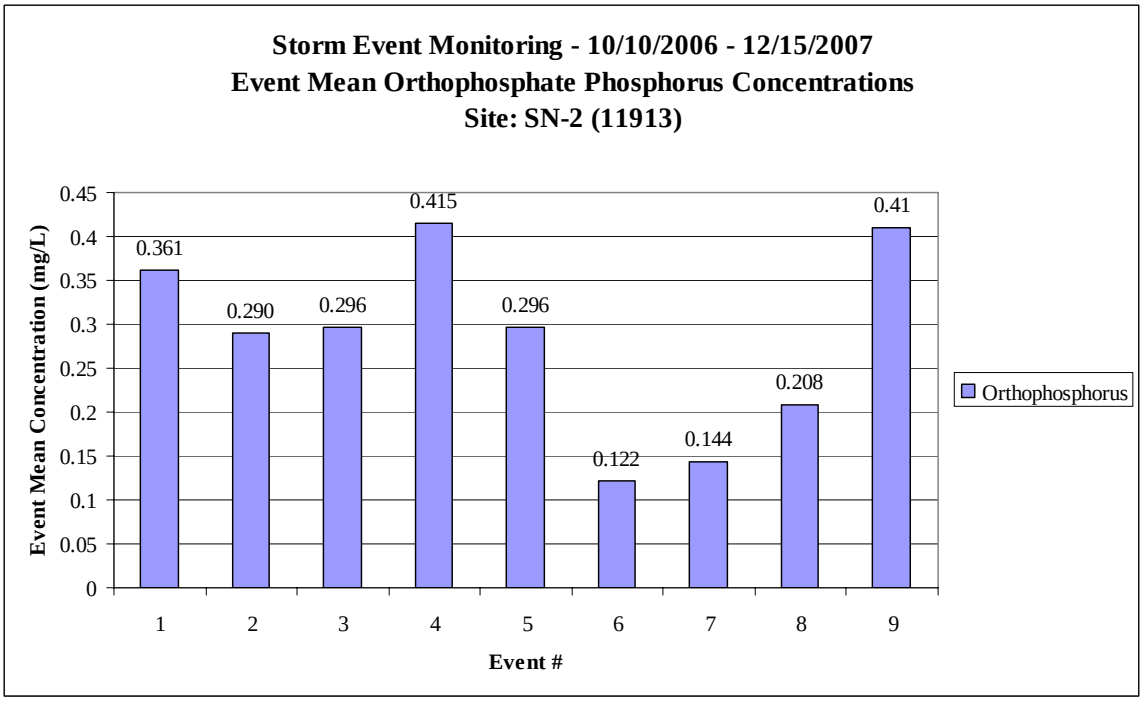


Figure E-7. Storm Event Monitoring Results – Orthophosphate Phosphorus EMC

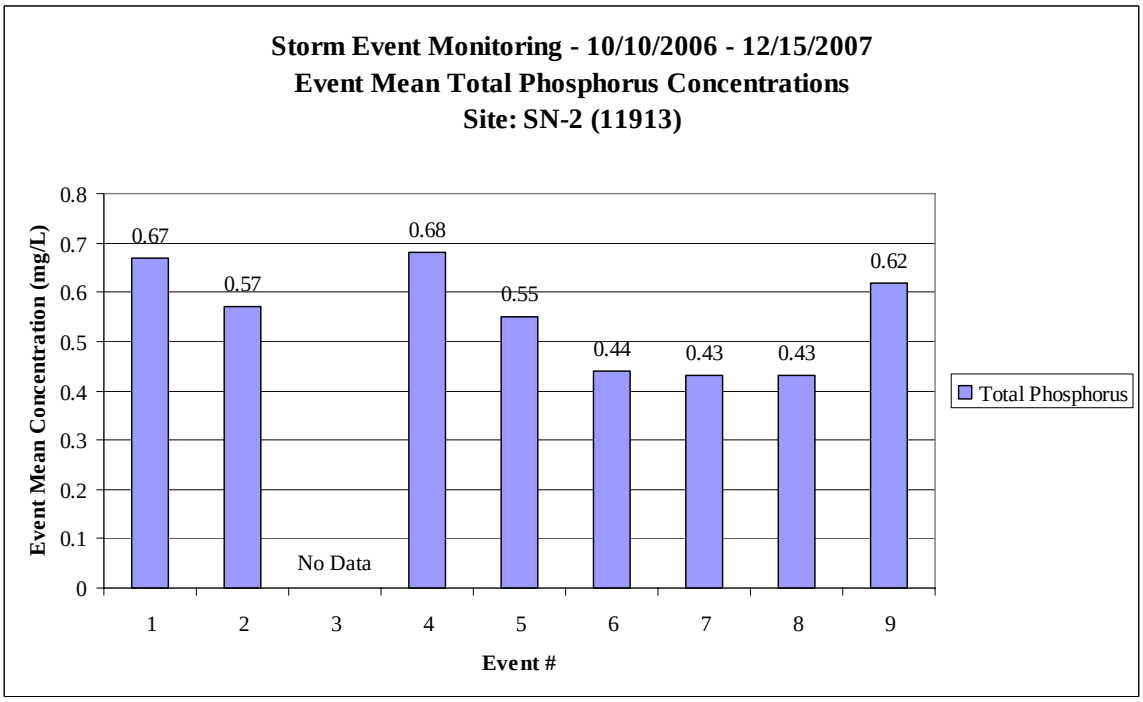


Figure E-8. Storm Event Monitoring Results – Total Phosphorus EMC

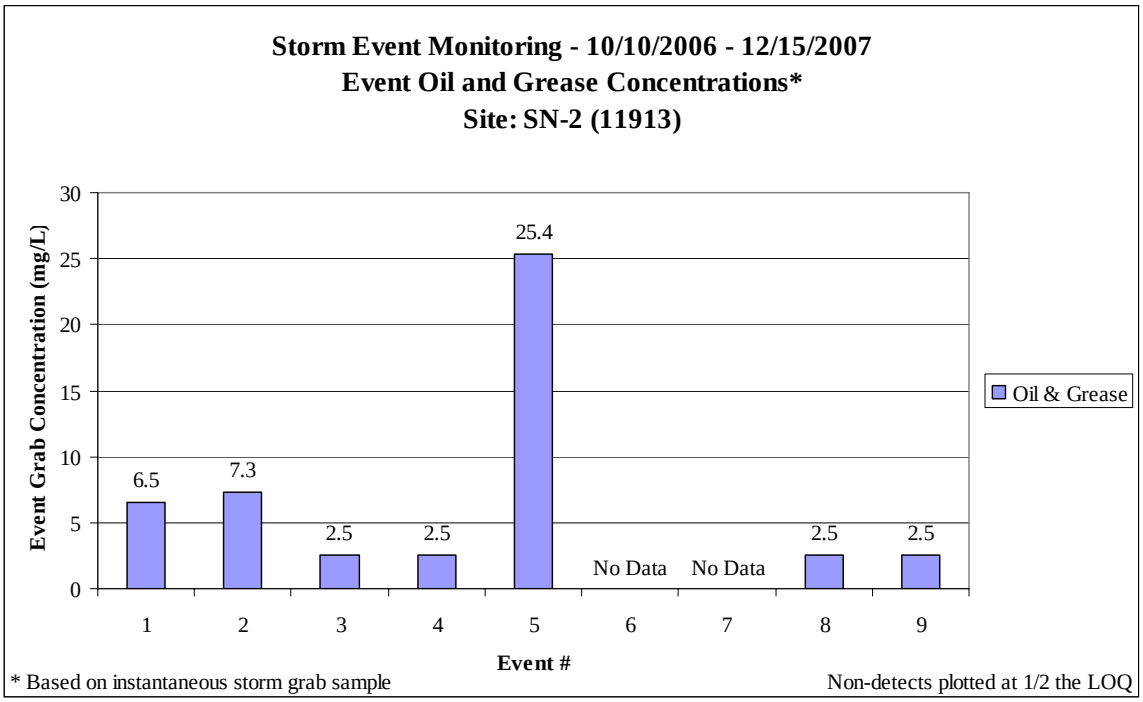


Figure E-9. Storm Event Monitoring Results – Oil and Grease Concentrations

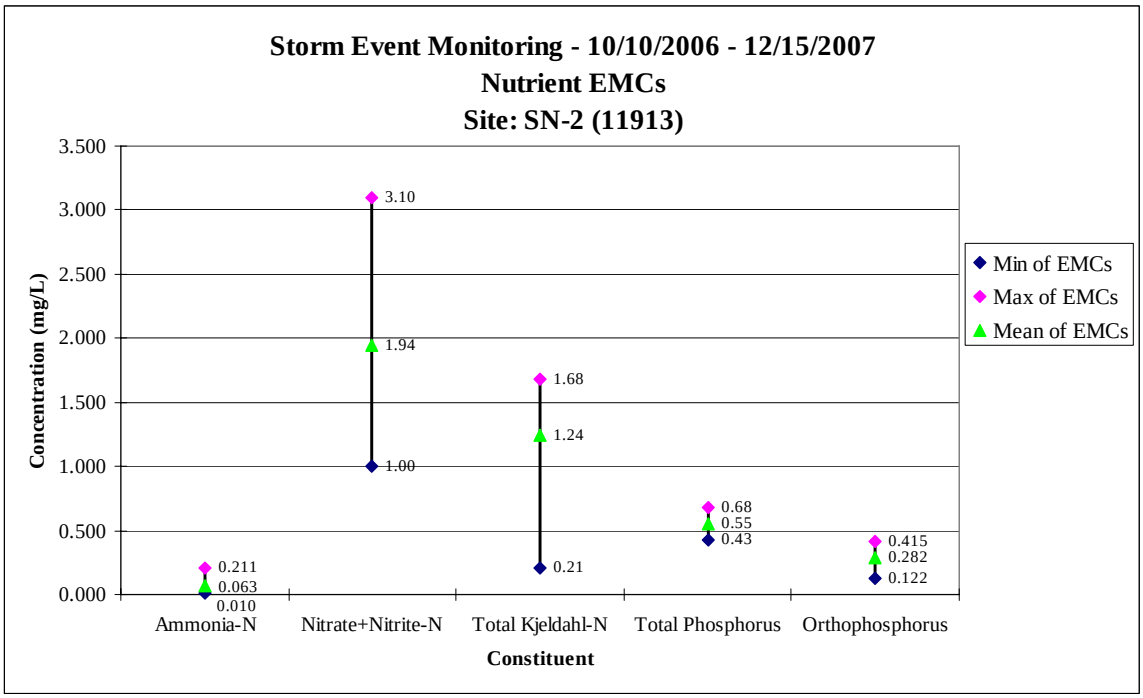


Figure E-10. Minimum, Maximum, and Mean EMCs for Nutrients

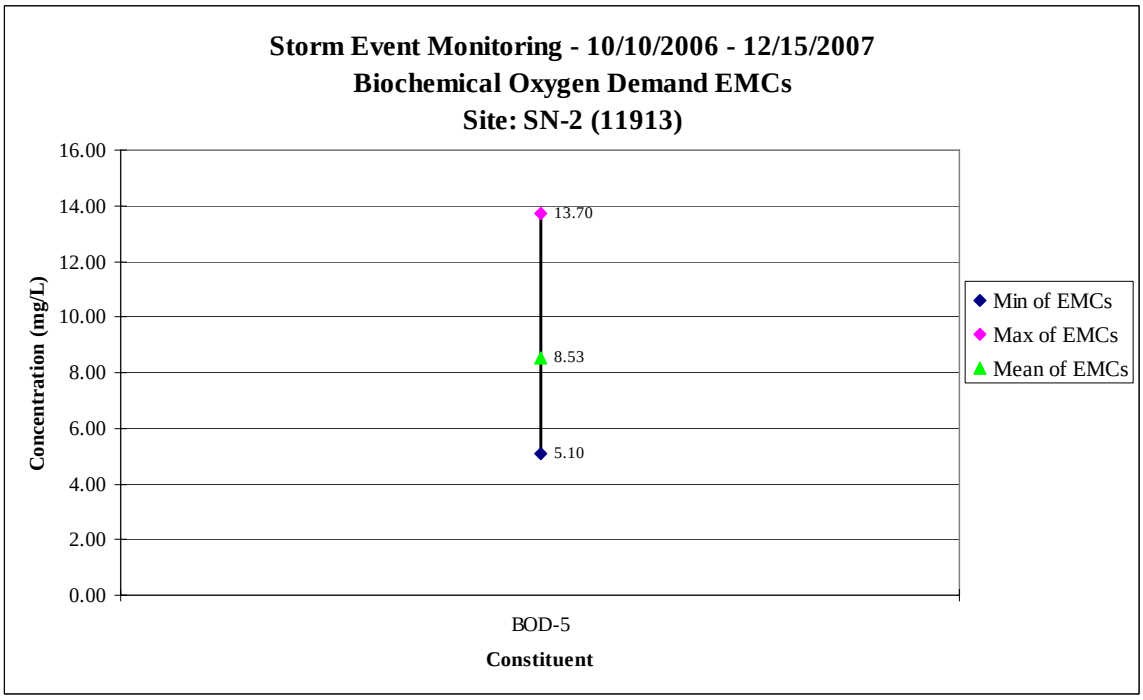


Figure E-11. Minimum, Maximum, and Mean EMCs for BOD5

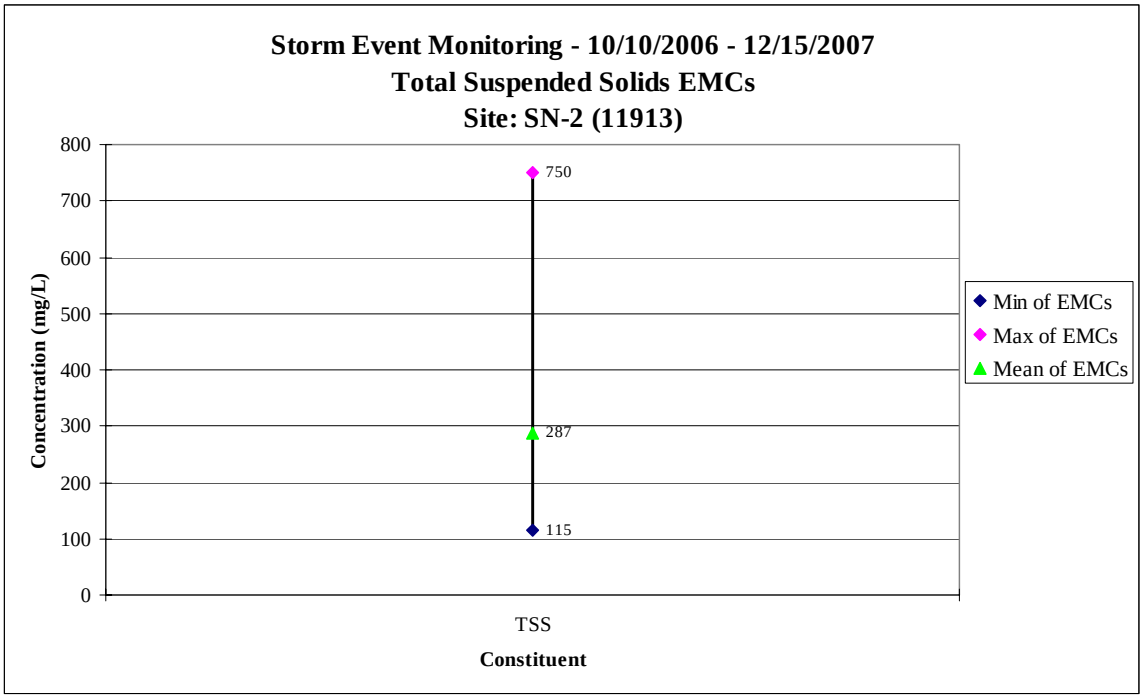


Figure E-12. Minimum, Maximum, and Mean EMCs for TSS

Appendix F: Metals Monitoring Data

Ambient and Storm Event Monitoring

October 2006 – February 2008

Table F-1. Analytical Results for Ambient and Wet-Weather Metals Monitoring in the South Nolan Creek Watershed

						Concentration (mg/L)																					
Lab ID	TCEQ Site	Killeen Site ID	Date	Time	Sample Type	As_dis_Qual	Arsenic (Dissolved)	Ba_dis_Qual	Barium (Dissolved)	Cd_dis_Qual	Cadmium (Dissolved)	Cu_dis_Qual	Copper (Dissolved)	Pb_dis_Qual	Lead (Dissolved)	Ni_dis_Qual	Nickel (Dissolved)	Ag_dis_Qual	Silver (Dissolved)	Zn_dis_Qual	Zinc (Dissolved)	Cr_tot_Qual	Chromium (Total)	Mn_tot_Qual	Manganese (Total)	Se_tot_Qual	Selenium (Total)
278032-001, -002	11913	SN-2	10/11/2006	8:50	Storm Grab	<	0.002		0.034	<	0.0003	<	0.003	<	0.001		0.005	<	0.0005		0.027		0.005		0.008	<	0.002
278032-003, -004	11913	SN-2	10/16/2006	11:10	Storm Grab	<	0.002		0.075	<	0.0003	<	0.003	<	0.001		0.003	<	0.0005		0.037		0.006		0.037	<	0.002
278032-005, -006	18829	SN-6	1/11/2007	10:01	Semi-Annual Grab		0.001		0.099	<	0.0003	<	0.003	<	0.001		0.010	<	0.0005	<	0.005		0.003		0.132		0.004
278032.007, -008	15271	SN-5	1/11/2007	10:51	Semi-Annual Grab	<	0.002		0.068	<	0.0003	<	0.003	<	0.001		0.008	<	0.0005		0.005		0.004		0.008	<	0.002
278032-009, 010	18828	SN-4	1/11/2007	11:34	Semi-Annual Grab	<	0.002		0.042	<	0.0003		0.004	<	0.001		0.007	<	0.0005		0.050		0.004		0.005	<	0.002
278032-011, -012	18827	SN-3	1/11/2007	12:15	Semi-Annual Grab	<	0.002		0.041	<	0.0003		0.004	<	0.001		0.007	<	0.0005		0.049		0.003		0.004	<	0.002
278032-013, -014	11913	SN-2	1/11/2007	12:57	Semi-Annual Grab	<	0.002		0.046	<	0.0003		0.003	<	0.001		0.007	<	0.0005		0.040		0.004		0.003	<	0.002
278032-015, -016	11913	SN-2	1/11/2007	12:57	Semi-Annual Grab	<	0.002		0.047	<	0.0003		0.003	<	0.001		0.007	<	0.0005		0.040		0.004		0.003	<	0.002
283340-001, -002	11913	SN-2	4/18/2007	11:20	Storm Grab	<	0.002		0.034	<	0.0003	<	0.003	<	0.001	<	0.005	<	0.0005		0.014	<	0.006		0.004	<	0.002
283340-003, -004	11913	SN-2	5/1/2007	8:55	Storm Grab	<	0.002		0.010	<	0.0003	<	0.003	<	0.001	<	0.005	<	0.0005	<	0.005		0.010		0.194	<	0.002
283340-005, -006	11913	SN-2	5/2/2007	8.55	Storm Grab	<	0.002		0.033	<	0.0003	<	0.003	<	0.001	<	0.005	<	0.0005	<	0.005	<	0.006		0.016	<	0.002
288154-011, -012	11913	SN-2	6/14/2007	12:46	Storm Grab		0.002		0.029		0.0004		0.006		0.001	<	0.005	<	0.0010		0.007	<	0.003		0.026	<	0.002
288154-009, -010	11913	SN-2	6/15/2007	9:37	Storm Grab	<	0.002		0.035	<	0.0003	<	0.003	<	0.001	<	0.005	<	0.0010	<	0.003	<	0.003		0.020	<	0.002
288154-001, -002	18828	SN-4	7/18/2007	10:36	Semi-Annual Grab	<	0.002		0.043	<	0.0003	<	0.003	<	0.001	<	0.005	<	0.0010		0.017	<	0.003		0.006	<	0.002
288154-003, -004	15271	SN-5	7/18/2007	9:55	Semi-Annual Grab	<	0.002		0.046	<	0.0003	<	0.003	<	0.001	<	0.005	<	0.0010	<	0.003	<	0.003		0.025	<	0.002
288154-005, -006	18829	SN-6	7/18/2007	9:04	Semi-Annual Grab	<	0.002		0.072	<	0.0003	<	0.003	<	0.001	<	0.005	<	0.0010	<	0.003	<	0.003		0.072	<	0.002
288154-007, -008	18829	SN-6	7/18/2007	9:04	Semi-Annual Grab	<	0.002		0.068	<	0.0003	<	0.003	<	0.001	<	0.005	<	0.0010	<	0.003	<	0.003		0.072	<	0.002
288154-013, -014	18827	SN-3	7/18/2007	11:27	Semi-Annual Grab		0.003		0.047		0.0004	<	0.003		0.001	<	0.005	<	0.0010		0.013	<	0.003		0.008	<	0.002
288154-015, -016	11913	SN-2	7/18/2007	12:06	Semi-Annual Grab		0.003		0.051		0.0004		0.008		0.001	<	0.005	<	0.0010		0.009	<	0.003		0.007	<	0.002
297502-010, -011	11913	SN-2	9/5/2007	8:55	Storm Grab	<	0.002		0.035	<	0.0003	<	0.003		0.001	<	0.005	<	0.0010		0.009	<	0.003	<	0.003	<	0.002
297502-001	11913	SN-2	12/15/2007	13:35	Storm Grab	<	0.002		0.030	<	0.0003		0.003	<	0.001	<	0.005	<	0.0010		0.016						
297502-007, -006	18829	SN-6	1/9/2008	13:16	Semi-Annual Grab		0.003		0.094	<	0.0003	<	0.003	<	0.001	<	0.005	<	0.0010		0.006	<	0.003		0.249	<	0.002
297502-008, -009	15271	SN-5	1/9/2008	13:52	Semi-Annual Grab	<	0.002		0.049	<	0.0003	<	0.003	<	0.001	<	0.005	<	0.0010	<	0.003	<	0.003		0.007	<	0.002
297502-012, -013	18828	SN-4	1/9/2008	14:40	Semi-Annual Grab	<	0.002		0.040	<	0.0003		0.009	<	0.001	<	0.005	<	0.0010		0.060	<	0.003		0.006	<	0.002
297502-014, -015	18828	SN-4	1/9/2008	14:40	Semi-Annual Grab	<	0.002		0.040	<	0.0003		0.010	<	0.001	<	0.005	<	0.0010		0.056	<	0.003		0.004	<	0.002
297502-016, -017	18827	SN-3	1/9/2008	15:32	Semi-Annual Grab	<	0.002		0.036	<	0.0003		0.008	<	0.001	<	0.005	<	0.0010		0.049	<	0.003		0.005	<	0.002
297502-018, -019	11913	SN-2	1/9/2008	16:07	Semi-Annual Grab	<	0.002		0.041	<	0.0003		0.007	<	0.001	<	0.005	<	0.0010		0.045	<	0.003		0.004	<	0.002

Some of the data in the table above had QA flags from Xenco laboratory. Flagged data was not submitted to TCEQ as part of the data submission but is included here for informational purposes.

Table F-2. Descriptive Statistics for Metals

Statistic	Arsenic (Dissolved)	Barium (Dissolved)	Cadmium (Dissolved)	Copper (Dissolved)	Lead (Dissolved)	Nickel (Dissolved)	Silver (Dissolved)	Zinc (Dissolved)	Chromium (Total)	Note	Manganese (Total)	Selenium (Total)
Minimum (mg/L)	0.001	0.010	0.0003	0.003	0.001	0.003	0.0005	0.003	0.003		0.003	0.002
Maximum (mg/L)	0.003	0.099	0.0004	0.010	0.001	0.010	0.0010	0.060	0.010		0.249	0.004
Average (mg/L)	0.002	0.048	0.0003	0.004	0.001	0.006	0.0008	0.021	0.004		0.036	0.002
Aquatic Life Chronic Criteria (Note H)	0.1900	--	0.0015	0.0184	0.0046	0.2339	--	0.1556	0.0106	A	--	0.0050
Aquatic Life Acute Criteria (Note H)	0.3600	--	0.0559	0.0287	0.1320	2.1065	0.0008	0.1495	0.0157	A	--	0.0200
Human Health Protection (Water & Fish)	0.05	2	0.005	--	0.00498	--	--	--	--		--	0.05
Do any samples exceed aquatic life criteria?	no		no	no	no	no	no	no	no			no
Do any samples exceed human health criteria?	no	no	no		no							no

Qualifiers and Notes:
A Aquatic Life Criteria for Chromium is for Hexavalent (dissolved), Comparison of total measured to the dissolved criteria (if total does not exceed than neither does the dissolved fraction)
-- Criteria not developed
H Computed based on a Hardness of 160 and a Water Effects Ratio of 1, Source: page 166, Segment 1218, Procedures to Implement the Texas Surface Water Quality Standards, TCEQ, January 2003
For data below the LOQ, the values were set at the LOQ to compute descriptive statistics (Minimum, Maximum, and Mean).