Chapter 4

Pollutant Sources

Pollutants may come from many sources and fall into either the category of point sources or nonpoint sources. Point source pollutants come from a single definable point, such as a pipe. Nonpoint source pollutants originate from multiple locations and rainfall runoff washes them into surface waters. Point and nonpoint sources in this section are presented to give a general account of the various sources of pollutants expected in the watershed.

4.1 Point Sources

In environmental and regulatory contexts, a point source refers to any discernible, confined, and discrete conveyance from which pollutants are or may be discharged. Point sources can take various forms, including pipes, channels, or conduitsThe critical aspect is that they are identifiable and defined. Point sources are often associated with industrial facilities, wastewater treatment plants, and other specific discharge points. Point source discharges require permits under the National Pollutant Discharge Elimination System (NPDES)[1] and Texas Pollutant Discharge Elimination System (TPDES)[2].

4.1.1 Domestic and Industrial Wastewater Treatment Plants

Wastewater is a byproduct of virtually every human activity and can contain a variety of pollutants, each of which differs in their effects on the environment. Domestic wastewater (also called municipal wastewater) is the effluent and sewage that comes from domestic households and businesses. Industrial wastewater consists of the effluent from various manufacturing and production facilities. WWTPs treat sewage and wastewater so that they can be returned to the environment. The discharge of wastewater into or adjacent to water in Texas is authorized by TCEQ through its permitting process. Data on permitted facilities in the state and location of their wastewater outfalls can be accessed from TCEQ's geographic information system (GIS) data hub[3] and Central Registry Query[4].

---

[1] The National Pollutant Discharge Elimination System permit program addresses water pollution by regulating point sources that discharge pollutants to surface waters. Additional information about the program is available at https://www.epa.gov/npdes

[2] Regulatory program to control discharges of pollutants to surface waters in Texas. Additional information about the program is available at https://www.tceq.texas.gov/permitting/wastewater/pretreatment/tpdes_definition.html

[3] TCEQ Wastewater Outfalls data. https://gis-tceq.opendata.arcgis.com/

[4] TCEQ Central Registry Query. https://www15.tceq.texas.gov/crpub/index.cfm?fuseaction=home.welcome

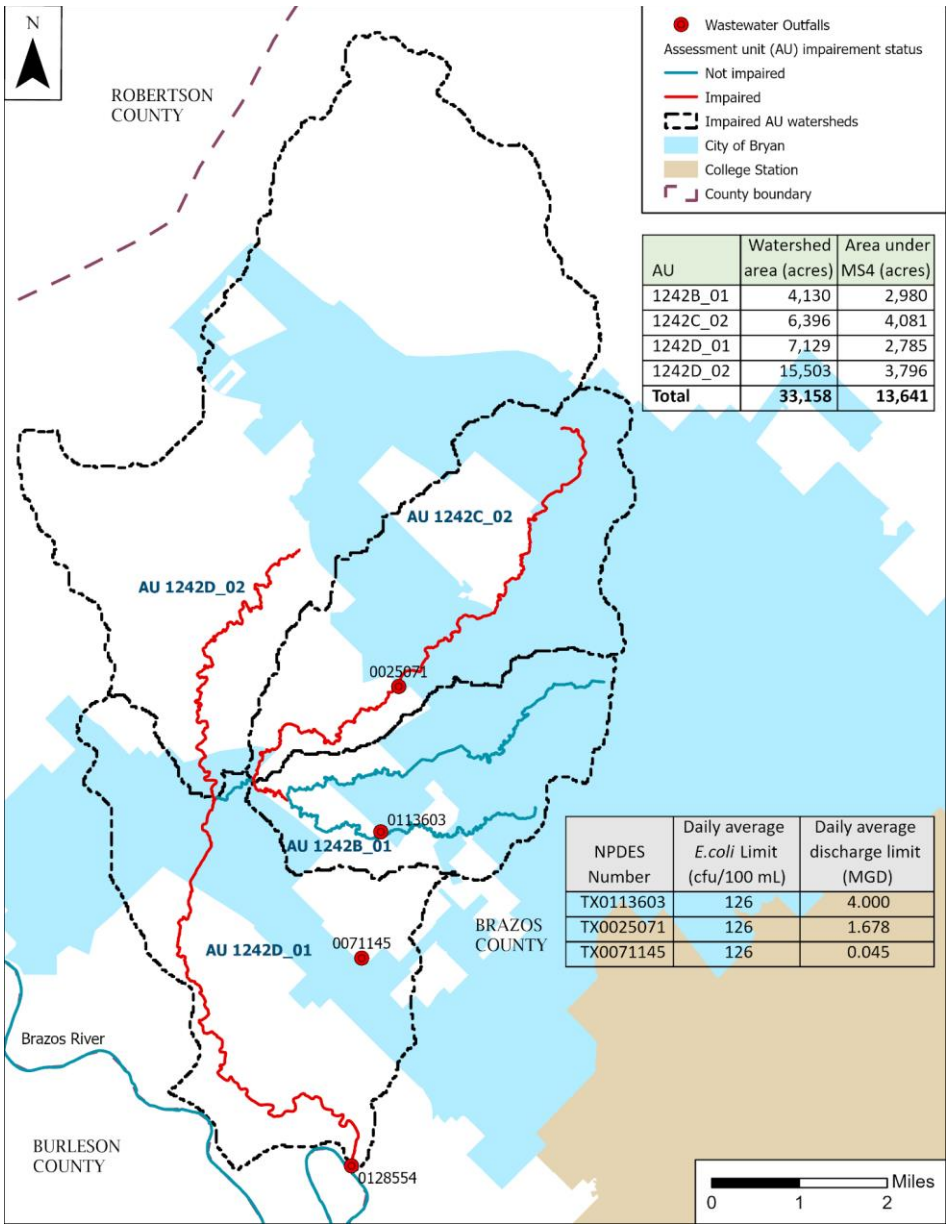
A review of these sources found four facilities with wastewater discharge permits in the Thompsons Creek watershed (Figure 4-1). The Riverside WWTP, Still Creek WWTP, and Thompsons Creek WWTP treat domestic wastewater. The Sanderson Farms facility produces industrial wastewater associated with poultry processing.

4.1.1.1 Sanderson Farms, Inc WWTP

The Sanderson Farms facility is authorized to treat and discharge wastes from Sanderson Farms, a poultry processing facility to an unnamed tributary of Cottonwood Branch according to effluent limitations, monitoring requirements, and other conditions on TPDES Permit No. WQ0003821000 (NPDES No. TX0113603). Effluent characteristics and discharge limitations for this WWTP are listed in Table 4-1.

Table 4-1. Selected effluent characteristics and discharge limitations for Sanderson Farms, Inc WWTP.

Effluent Characteristics	Discharge limitation – Daily average within a calendar month	Discharge limitation – Daily Maximum within a calendar month	Discharge limitation – Single Sample
Flow	1.678 MGD	2.34 MGD	N/A
Carbonaceous Biochemical Oxygen Demand (5-day)	140 lbs/day	280 lbs/day	30 mg/L
Total Suspended Solids	210 lbs/day	280 lbs/day	30 mg/L
Ammonia Nitrogen	42 lbs/day	84 lbs/day	9 mg/L
E. coli	126 cfu/100 mL	399 cfu/100 mL	399 cfu/100 mL
Total Nitrogen	1875 lbs/day	26778 lbs/day	300 mg/L



AU	Watershed area (acres)	Area under MS4 (acres)
1242B_01	4,130	2,980
1242C_02	6,396	4,081
1242D_01	7,129	2,785
1242D_02	15,503	3,796
Total	**33,158**	**13,641**

NPDES Number	Daily average *E.coli* Limit (cfu/100 mL)	Daily average discharge limit (MGD)
TX0113603	126	4.000
TX0025071	126	1.678
TX0071145	126	0.045

Figure 4-1. Permitted wastewater outfalls and regulated stormwater area in the watershed.

Commented [WH1]: Outfall 0128554 isn't listed in that NPDES table on the map

4.1.1.2 Still Creek WWTP

The City of Bryan is authorized to treat and discharge wastes from the Still Creek Wastewater Treatment Facility to Still Creek according to effluent limitations, monitoring requirements, and other conditions on TPDES Permit No. WQ0010426002 (NPDES No. TX0025071). Effluent characteristics and discharge limitations for this WWTP are listed in Table 4-2.

Table 4-2. Selected effluent characteristics and discharge limitations for the Still Creek WWTP.

Effluent Characteristics	Discharge limitation – Daily average within a calendar month	Discharge limitation – Daily Maximum within a calendar month	Discharge limitation – Single Sample
Flow	1.678 MGD	0.925 MGD	N/A
Carbonaceous Biochemical Oxygen Demand (5-day)	10 mg/L	25 mg/L	35 mg/L
Total Suspended Solids	15 mg/L	40 mg/L	60 mg/L
Ammonia Nitrogen	3 mg/L	10 mg/L	15 mg/L
E. coli	126 cfu/100 mL	399 cfu/100 mL	N/A

4.1.1.3 Riverside WWTP

The permit issued for the Riverside WWTP authorizes the facility to treat and discharge waste to the unnamed tributary of Thompsons Creek (WQ0011778001, NPDES No. TX0071145). Effluent characteristics and discharge limitations for this WWTP are listed in Table 4-3.

Table 4-3. Selected effluent characteristics and discharge limitations for the Riverside Creek WWTP.

Effluent Characteristics	Discharge limitation – Daily average within a calendar month	Discharge limitation – Daily Maximum within a calendar month	Discharge limitation – Single Sample
Flow	0.045 MGD	0.018	N/A
Biochemical Oxygen Demand (5-day)	20 mg/L	45 mg/L	65 mg/L
Total Suspended Solids	20 mg/L	45 mg/L	65 mg/L
E. coli	126 cfu/100 mL	N/A	399 cfu/100 mL

4.1.1.4 Thompsons Creek WWTP

The City of Bryan is authorized to treat and discharge wastes from the Thompsons Creek Wastewater Treatment Facility to the Brazos River Above Navasota River according to effluent limitations, monitoring requirements, and other conditions on TPDES Permit No. WQ0010426004 (NPDES No. TX0128554). Although the WWTP is located in the Thompsons Creek watershed, the treated wastewater is discharged to the Brazos River, downstream of all monitoring stations in the Thompsons Creek watershed.

4.1.1.4 Compliance

The EPA's Enforcement and Compliance History Online[5] (ECHO) provides public access to compliance and enforcement information for EPA regulated facilities. A summary of the compliance history for WWTPs discharging to water bodies in the Thompsons Creek watershed is presented in Table 4-4.

Table 4-4. Summary of compliance history for WWTPs in the Thompsons Creek Watershed.

Assessment Unit	Estimated Incidents	Total Volume (gallons)	Maximum Volume (gallons)
1242B_01	2	630	600
1242B_02	1	1,000	1,000
1242C_01	39	45,115,023	45,000,000
1242D_01	6	100,581	100,000
1242D_02	2	11,500	10,000

Commented [WH2]: Would it be appropriate add a column to include the WWTP or permit number, so the reader doesn't have to refer back to the map to figure out which WWTP is the relevant one?

Commented [WH3]: What exactly is this max? Is it a daily value?

4.1.2 General Wastewater Permits

In addition to the individual wastewater discharge permits, certain types of activities must be covered by one of several TCEQ/TPDES wastewater general permits:

- TXG110000 – concrete production facilities
- TXG130000 – aquaculture production
- TXG340000 – petroleum bulk stations and terminals
- TXG640000 – conventional water treatment plants

[5] EPA Enforcement and Compliance History Online website. https://echo.epa.gov/

- TXG670000 – hydrostatic test water discharges
- TXG830000 – water contaminated by petroleum fuel or petroleum substances.
- TXG870000 – pesticides (application only)
- TXG920000 – concentrated animal feeding operations
- WQG100000 – wastewater evaporation
- WQG200000 – livestock manure compost operations (irrigation only)

A review of active general permits using TCEQ'S water quality general permits search application[6] in the Thompsons Creek watershed found two general authorizations for concrete production facilities. These facilities do not have bacteria requirements or limits in their permits. The permits authorize discharge of stormwater and are implicitly included in the regulated stormwater allocations.

4.1.3 TPDES-Regulated Stormwater

TPDES Municipal Separate Storm Sewer System (MS4) Phase I and II rules require municipalities and certain other entities in urbanized areas to obtain permit coverage for their stormwater systems. A regulated MS4 is a publicly owned system of conveyances and includes ditches, curbs, gutters, and storm sewers that do not connect to a wastewater collection system or treatment facility. Phase I permits are individual permits for large and medium-sized communities with populations of 100,000 or more based on the 1990 U.S Census, while the Phase II General Permit regulates other MS4s within a USCB defined urbanized area.

The purpose of an MS4 permit is to reduce discharges of pollutants in stormwater to the "maximum extent practicable" by developing and implementing a stormwater management program (SWMP). The SWMP describes the stormwater control practices that the regulated entity will implement, consistent with permit requirements, to minimize the discharge of pollutants. MS4 permits require that SWMPs specify the BMPs to meet several minimum control measures (MCMs) that, when implemented in concert, are expected to result in significant reductions of pollutants discharged into receiving water bodies. Phase I MS4 individual permits have their own set of MCMs that are similar to the Phase II

[6] TCEQ Water Quality General Permits Search application. Data retrieved on 10/06/2023 from https://www2.tceq.texas.gov/wq_dpa/index.cfm

MCMs, but Phase I permits have additional requirements, such as having a water quality monitoring program.

Discharges of stormwater from a Phase II MS4 area, regulated industrial facility, construction area, or other facility involved in certain activities must be authorized under one of the following general permits:

- TXR040000 – Phase II MS4 General Permit for small MS4s located in urbanized areas (discussed above).
- TXR050000 – MSGP for industrial facilities.
- TXR150000 – Construction General Permit (CGP) for construction activities disturbing more than one acre or that are part of a common plan of development disturbing more than one acre.

A review of active general permits carried out in November 2023 using TCEQ'S water quality general permits search application[7] found one active Phase II MS4 permit held by the City of Bryan, 39 MSGPs, and 45 CGPs in the Thompsons Creek watershed. The area of regulated stormwater by the MS4 permit includes the incorporated areas of the City of Bryan, which is approximately 41% of the Thompsons Creek watershed (Figure 4.1).

4.1.4 Sanitary Sewer Overflows

Sanitary sewers are systems that collect and transport wastewater to appropriate treatment facilities. The release of raw sewage from these lines, also known as a sanitary sewer overflow (SSO) event, happens when sewer lines fail due to age, lack of maintenance, or are overloaded during rain events. SSOs are unauthorized discharges that must be addressed by the responsible party, either the TPDES permittee or the owner of the collection system that is connected to a permitted system.

Stormwater permit violation information is provided by TCEQ upon request. TCEQ Central Office in Austin provided statewide data on SSO incidents from January 2016 through December 2021 (TCEQ 2022e). Table 4.5 summarizes the number of SSO incidents reported by regulated entities operating

Commented [WH4]: I shared an SSO report with Duncan that had data through October 2023. Is this referring to a different report?
Also I couldn't find TCEQ 2022e in the references

[7] TCEQ Water Quality General Permits Search application. Data retrieved on 10/06/2023 from https://www2.tceq.texas.gov/wq_dpa/index.cfm

within the watershed from 2020-2022. Most of the incidents reported in the watershed during this period were sewage overflows caused by grease blockages and manhole overflows.

Commented [WH5]: Date range doesn't match previous sentence or Figure 4.5 caption

Table 4.5. Summary of reported sanitary sewer overflow events from 2016 through 2021 in the Thompsons Creek watershed.

Assessment Unit	Incident type	Material	Volume (gallons)	Source/Cause	Year
1242C_01	Wastewater bypass	Sewage	500	Sewer Line	2020
1242C_01	Wastewater bypass	Sewage	50	Manhole	2020
1242C_01	Wastewater bypass	Sewage	100	Manhole	2020
1242C_01	Wastewater bypass	Sewage	30	Sewer line grease blockage	2020
1242C_01	Wastewater bypass	Sewage	1	Main line grease blockage	2021
1242C_01	Wastewater bypass	Sewage	10	Grease blockage	2022

4.1.5 Dry Weather Discharges/Illicit Discharges

Pollutant loads can enter water bodies from MS4 outfalls that carry authorized sources as well as illicit discharges. An illicit discharge is any material besides stormwater that drains or falls into the storm sewer system. Examples of direct illicit discharges include sanitary wastewater piping that is directly connected from a home to the storm sewer, materials that have been dumped illegally into a storm drain catch basin, or a shop floor drain that is connected to the storm sewer. Examples of indirect illicit discharges include an old and damaged sanitary sewer line that is leaking fluids into a cracked storm sewer line or a failing septic system that is leaking into a cracked storm sewer line or causing surface discharge into the storm sewer.

4.2 Unregulated Sources

Unregulated sources of bacteria are generally nonpoint. Nonpoint source pollution occurs when rainfall causes pollutants to runoff into drainage ditches, lakes, rivers, or other water bodies. Nonpoint source pollution can include bacteria from livestock or pet waste, wildlife waste, urban and agricultural runoff, failing OSSFs, and other sources.

4.2.1 Livestock

Domestic livestock and the use of their manure as fertilizer can introduce *E. coli* into water bodies. The Thompsons Creek watershed livestock populations were estimated using the National Agricultural Statistics Service (NASS) agriculture census data (USDA 2022). Since NASS data are county-based,

populations for cattle, horses, hogs, sheep, and goats were estimated based upon the percentage of rural area within the watershed (Table 4.6).

Table 4.6. Estimated livestock populations in the Thompsons Creek watershed.

Assessment unit	Cattle	Goats	Sheep	Horses
1242B_01	423	7	19	15
1242C_02	600	16	28	21
1242D_01	1,272	34	60	46
1242D_02	2,733	73	128	97
Total	5,028	79	223	182

4.2.2 Wildlife

Non-domesticated animals tend to live within the same type of habitat or land use: riparian corridors that are not barren or developed. Pollutants from wild animals enter the water body through direct deposition when wading and through runoff during a storm event. Feral hogs tend to be particularly destructive to riparian vegetation which also reduces the riparian area's capacity to filter pollutants from other sources. Estimates of most wildlife including raccoons, opossums, and birds are difficult to ascertain; therefore, management measures commonly focus on two species with practical management options: white-tailed deer and feral hogs (Table 4.7).

The Texas Parks and Wildlife Department (TPWD) provides deer population-density estimates by Resource Management Unit and Ecoregion in the state. The Thompsons Creek watershed area lies in Resource Management Unit 19 with an average deer density of 25.3 acres per deer in 2019 (TPWD 2020). Texas A&M AgriLife Extension (2012) estimates one hog per 39 acres as a statewide average density for feral hogs. Both species prefer similar land cover classes: forest, pasture, shrub, and wetlands. While they mostly travel through riparian corridors, they can also be found in the pastures, croplands, and rangelands, especially at night. Feral hogs are significant contributors of fecal bacteria to water bodies as they spend much of their time wallowing in and around the water. These non-native, invasive hogs also cause erosion and soil loss issues due to their rooting and wallowing habits.

4.2.3 Pets

Cats and dogs can be a major contributor to *E. coli* in a watershed if pet waste is not properly disposed. Table 4.7 summarizes the estimated number of dogs and cats in the watershed. Pet population estimates were calculated as the average number of dogs (0.614) and cats (0.457) per household according to data from the American Veterinary Medical Association (AVMA) 2017–2018 U.S. Pet Statistics (AVMA 2019). The number of households in the watershed was estimated using 2020 Census data.

Table 4.7. Wildlife and pet populations in the Thompsons Creek watershed

	Wildlife - Estimated population		Pets - Estimated population	
Assessment unit	Feral hogs	White-tailed deer	Dogs	Cats
1242B_01	39	91	1,786	1,258
1242C_02	60	140	2,674	1,884
1242D_01	120	239	275	194
1242D_02	257	538	752	530

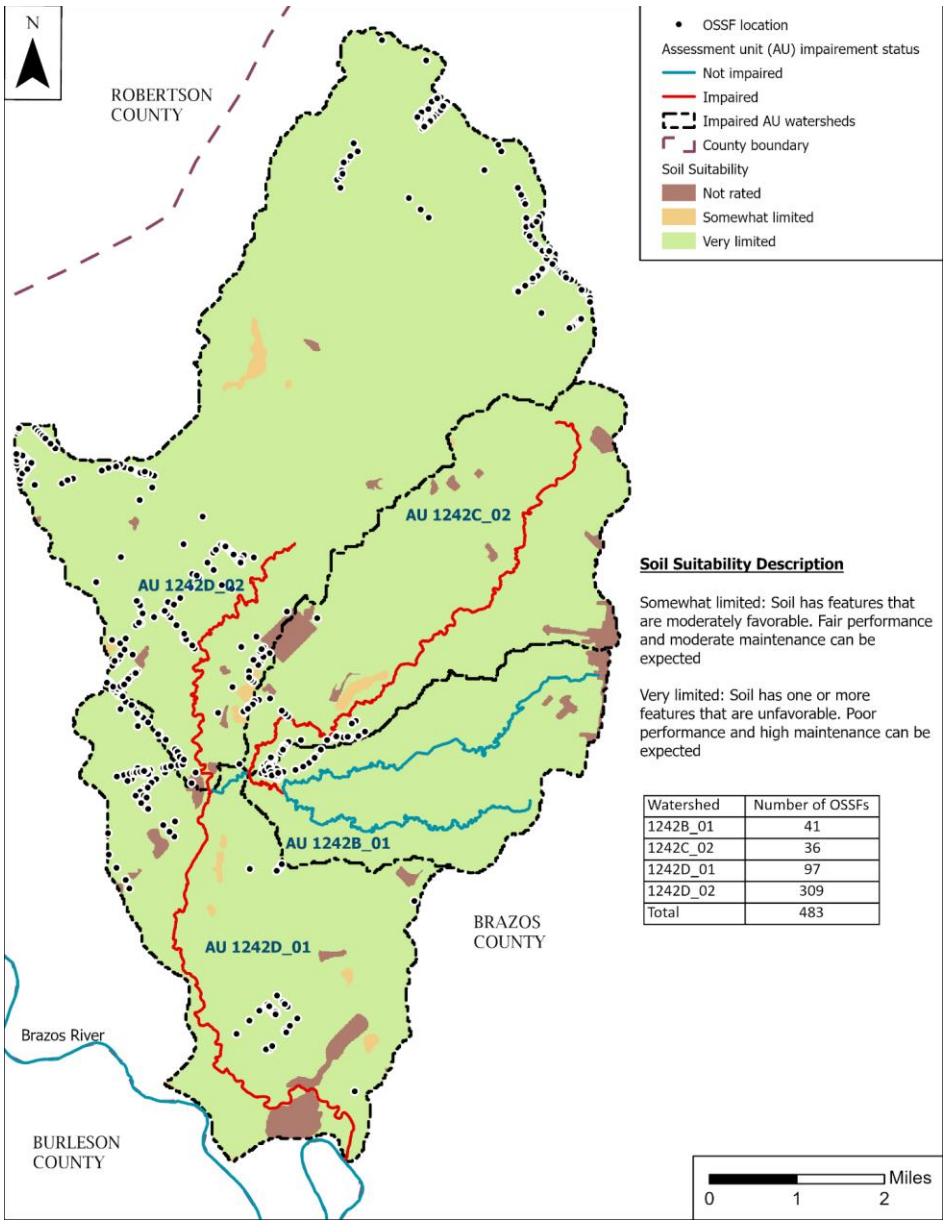
4.2.4 On-site Sewage Facilities

OSSFs are an acceptable wastewater treatment alternative for households that are unable to connect to municipal sewer systems. If OSSFs are properly designed, installed, routinely inspected, and effectively managed, they can provide an adequate level of waste treatment and disinfection. However, failing OSSFs can lead to nonpoint bacterial and nutrient contamination within a watershed.

Improper site design, age, and lack of maintenance like regular pumping and proper chlorination can cause OSSFs to fail to treat waste before it enters the environment. The ability of the soil to absorb wastewater affects the ability of a conventional OSSF to function as well. Soil suitability rankings for OSSF design were developed by NRCS based on topography, saturated hydraulic conductivity, depth to the water table, ponding, flooding, etc. (NRCS 2020), and soils were divided into three categories: not limited, somewhat limited, and very limited. OSSFs that are not properly designed, and in a somewhat limited or very limited soil type have increased risk of failure. The soils in the Thompsons Creek watershed are generally very limited (Figure 4.2).

Several pathways of the liquid waste in OSSFs afford opportunities for bacteria to enter ground and surface waters if the systems are not properly operating. Reed, Stowe, and Yanke LLC (2001) provide information on estimated failure rates of OSSFs for different regions of Texas. The Thompsons Creek watershed is located within the Region 4 area, which has a reported failure rate of about 12%, providing insights into expected failure rates for the area.

Estimates of the number of OSSFs in the Thompsons Creek watershed were determined using 911 address data to identify residence locations which were visually validated with aerial imagery data. Residential and business addresses that were outside of city boundaries, the area covered by the Certificates of Convenience and Necessity, and outside of the city's sewer system were assumed to have an OSSF (Public Utilities Commission of Texas 2017). Data from these sources indicate that there are 483 OSSFs located within the Thompsons Creek watershed (Figure 4.2).



Watershed	Number of OSSFs
1242B_01	41
1242C_02	36
1242D_01	97
1242D_02	309
Total	483

Figure 4.2. OSSF locations and NRCS soil suitability ratings for the Thompsons Creek watershed

4.2.5 Stormwater Runoff

Rainfall generated stormwater is a vehicle for almost all pollutant types that impact surface water bodies. Debris, dissolved pollutants, fecal matter, nutrients (nitrogen, phosphorus, etc.), sediment, and more are transported overland and into water bodies when sufficient rainfall occurs to create runoff. This is a natural and important process, but excess quantities of any of these constituents can be detrimental to instream water quality. Runoff occurs on all land cover and soil types when rainfall rates exceed the soil's infiltration capacity. Impervious surfaces including buildings, parking lots, and roadways are common in developed land uses. All impervious surfaces increase runoff generation to volumes above natural levels. In developed areas, the timing when water arrives in the stream is also altered and generally leads to increased peak flows which lead to higher flooding potential. Combined, these factors can all have adverse effects on instream water quality.

4.2.6 Illegal Dumping

Improper waste disposal is an issue across the Thompsons Creek watershed and the surrounding area. Although most trash items dumped are not necessarily major sources of bacteria and nutrient pollution, areas that are littered tend to become dumping areas for others as well, which can cause blockages and flooding or more surface area for bacteria to grow on. Other commonly dumped items, like animal carcasses and household chemical containers, can contribute additional bacteria and nutrients to the watershed.

American Veterinary Medical Association 2019. American Veterinary Medical Association U.S. Pet Ownership Statistics. Accessed on 10/09/2023. https://www.avma.org/resources-tools/reports-statistics/us-pet-ownership-statistics

Borel, K., Karthikeyan, R., Berthold, A. T., Wagner, K. 2015. Estimating *E. coli* and Enterococcus loads in a coastal Texas watershed. Texas Water Journal. 6 (1):33-44. https://doi.org/10.21423/twj.v6i1.7008.

Dewitz, J., 2023, National Land Cover Database (NLCD) 2021 Products: U.S. Geological Survey data release [Dataset]. Available online. Downloaded on 10/26/2023. https://doi.org/10.5066/P9JZ7AO3

Griffith, G., Bryce, S., Omernik, J., & Rogers, A. 2007. Ecoregions of Texas. Texas Commission on Environmental Quality. http://ecologicalregions.info/htm/pubs/TXeco_Jan08_v8_Cmprsd.pdf

Larkin, T.J. and Bomar, G.W. 1983. Climatic Atlas of Texas: Texas Water Development Board Limited Publication 192. https://www.twdb.texas.gov/publications/reports/limited_printing/doc/LP192.pdf

National Weather Service. 2023. Climate. Available online. Downloaded on 10/06/2023. https://www.weather.gov/wrh/climate

Reed, Stowe, and Yanke, LLC. (2001). Study to Determine the Magnitude of, and Reasons for, Chronically Malfunctioning On-site Sewage Facility Systems in Texas. Retrieved from https://www.tceq.texas.gov/assets/public/compliance/compliance_support/regulatory/ossf/StudyToDetermine.pdf

Soil Survey Staff, NRCS. 2022. Web Soil Survey. Available online. Downloaded on 10/16/2023. https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

Texas Commission on Environmental Quality (TCEQ). 2022a. 2022 Texas Integrated Report of Surface Water Quality. https://www.tceq.texas.gov/waterquality/assessment/22twqi

TCEQ. 2022b. 2022 Texas Surface Water Quality Standards. https://www.tceq.texas.gov/waterquality/standards

TCEQ. 2023. Surface water quality web reporting tool (database). Available online. Retrieved on 10/18/2023. https://www80.tceq.texas.gov/SwqmisPublic/index.htm

Texas Water Development Board. 2021. Regional Water Plan County Population Projections. https://www3.twdb.texas.gov/apps/reports/Projections/2022%20Reports/pop_county

USCB (United States Census Bureau). 2020a. 2020 TIGER/Line Shapefiles. Available online. Downloaded on 10/20/2023. https://www.census.gov/geographies/mapping-files.html

USCB. 2020b. Decennial Census of Population and Housing Data. Available online. Retrieved on 10/16/2023. https://data.census.gov/

United States Department of Agriculture (USDA). 2017. Census of Agriculture. https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_2_County_Level/Texas/.

U.S. Environmental Protection Agency (EPA). 1996. Watershed Approach Framework. https://www.epa.gov/sites/default/files/2015-06/documents/watershed-approach-framework.pdf

EPA 2001. Protocol for Developing Pathogen TMDLs: Source Assessment. 1st Edition. Washington, DC: U.S. Environmental Protection Agency. EPA 841-R-00-002. https://ntrl.ntis.gov/NTRL/dashboard/searchResults/titleDetail/PB2005107536.xhtml

EPA 2008. Handbook for Developing Watershed Plans to Restore and Protect Our Waters. https://www.epa.gov/nps/handbook-developing-watershed-plans-restore-and-protect-our-waters

EPA 2012. Identifying and Protecting Healthy Watersheds. https://www.epa.gov/sites/default/files/2015-10/documents/hwi-watersheds-complete.pdf

EPA. 2023. Ecoregions of North America [Dataset]. Available online. Downloaded on 10/14/2023. https://www.epa.gov/eco-research/ecoregions-north-america

U.S. Geological Survey (USGS). 2023a. 1/3rd arc-second Digital Elevation Models (DEMs) - USGS National Map 3DEP Downloadable Data Collection: U.S. Geological Survey. Available online. Downloaded on 10/26/2023. https://www.sciencebase.gov/catalog/item/4f70aa9fe4b058caae3f8de5

USGS 2023b. National Water Information System: Web interface (database). Available online. Retrieved on 10/18/2023. https://waterdata.usgs.gov/nwis

Wagner, K. L. and Moench, E. 2009. Education Program for Improved Water Quality in Copano Bay. Task Two Report. College Station, TX: Texas Water Resources Institute. TR-347. https://oaktrust.library.tamu.edu/handle/1969.1/93181.