

Chapter 02

Watershed Characterization

This chapter provides a geographic, demographic, and water quality overview of the Thompsons Creek watershed. Development of the information within this chapter relied heavily on state and federal data resources as well as local stakeholder knowledge. The collection of this information is critical for the reliable assessment of potential sources of water quality impairment and the recommendation of beneficial management measures.

2.1 Watershed Description and Impairment Overview

The Thompsons Creek watershed encompasses areas drained by Thompsons Creek and its tributaries in Brazos County, Texas. The watershed area spans nearly 33,158 acres of land that includes parts of the City of Bryan, Texas (Figure 2-1). The Texas Commission on Environmental Quality (TCEQ) divided waterbodies in the Thompsons Creek watershed into segments¹ and assessment units² (AUs) that TCEQ uses to incrementally evaluate water quality in the watershed. The watershed is comprised of three segments: Cottonwood Branch, Still Creek, Thompsons Creek, and Unnamed Tributary of Cottonwood Branch (Table 2-1). Thompsons Creek is a tributary of the Brazos River.

In compliance with Sections 305(b) and 303(d) of the Federal Clean Water Act (CWA), TCEQ evaluates water bodies in the state and identifies those that do not meet uses and criteria defined in the Texas Surface Water Quality Standards (TSWQS). TCEQ publishes the results as the Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d) (Texas Integrated Report). These reports include the support level³ for a particular use, method, or parameter group. The 2022 Texas

¹ Segment: a waterbody or portion of a waterbody that is individually defined and classified in the Texas Surface Water Quality Standards (TSWQS). A segment is intended to have relatively homogeneous chemical, physical, and hydrological characteristics. Unclassified waterbodies are not defined in the TSWQS, though associated with a classified waterbody in the same watershed.

² Assessment Units (AU): a sub-area of a stream segment, defined as the smallest geographic area of use support.

³ Level of support: A range of water quality conditions and assessment status is expressed by a level of support established in each AU. Support status can be described as fully supporting, concern for near non-attainment, concern for screening level, non-supporting, not assessed, no concern, or pending issue (TCEQ 2022a).

Integrated Report (TCEQ 2022a) lists several AUs in the watershed as impaired or as having use concerns (Table 2-2).

Table 2-1. TCEQ description of water bodies in the Thompsons Creek watershed

| Waterbody | Segment ID | Segment description | AU ID | AU description |
|--|------------|--|----------|---|
| Cottonwood Branch | 1242B | Intermittent stream with perennial pools from the confluence with Still Creek upstream 0.95 km to the confluence with an unnamed tributary | 1242B_01 | Portion of Cottonwood Branch from confluence with Still Creek upstream to unnamed tributary in Brazos County |
| | | | 1242B_02 | Portion of Cottonwood Branch from confluence with unnamed tributary upstream to headwaters in Brazos County |
| Still Creek | 1242C | Perennial stream from the confluence with Thompsons Creek upstream to the headwaters in Brazos County near US 190 | 1242C_01 | Perennial stream from the confluence with Thompsons Creek upstream to the confluence with Cottonwood Branch |
| | | | 1242C_02 | Portion of Still Creek from confluence with Cottonwood Branch upstream to headwaters in Brazos County near US 190 |
| Thompsons Creek | 1242D | Thompsons Creek - from the confluence of the Brazos River upstream to the confluence of Thompsons Branch, north of FM 1687 | 1242D_01 | Perennial stream from the confluence of the Brazos River upstream to the confluence of Still Creek in Brazos County |
| | | | 1242D_02 | Perennial pools from the confluence of Still Creek upstream to the confluence of Thompsons Branch, north of FM 1687 |
| Unnamed Tributary of Cottonwood Branch | 1242G | Intermittent stream with perennial pools from the confluence with Cottonwood Branch upstream to the headwaters | 1242G_01 | Same as the segment description |

Table 2-2. Waterbodies in the Thompsons Creek watershed with impairments or concerns on the 2022 Texas Integrated Report

| Waterbody | Segment ID | AU ID | Parameter of impairment or concern | Level of support* |
|-------------------|------------|----------|------------------------------------|-------------------|
| Cottonwood Branch | 1242B | 1242B_01 | Total phosphorus | CS |
| | | | Nitrate | CS |
| | | | Bacteria | NS |
| Still Creek | 1242C | 1242C_02 | Dissolved Oxygen | CS |
| | | | Total phosphorus | CS |
| | | | Nitrate | CS |
| | | | Bacteria | NS |
| Thompsons Creek | 1242D | 1242D_01 | Impaired fish community | CN |
| | | | Total phosphorus | CS |
| | | | Nitrate | CS |
| | | | Bacteria | NS |
| | | 1242D_02 | Dissolved Oxygen | NS |
| | | | Impaired macrobenthic community | CN |
| | | | Chlorophyll-a | CS |
| | | | Ammonia | CS |
| Bacteria | NS | | | |

* Level of support: NS = Nonsupport, CS = Screening Level Concern, CN = Use Concern

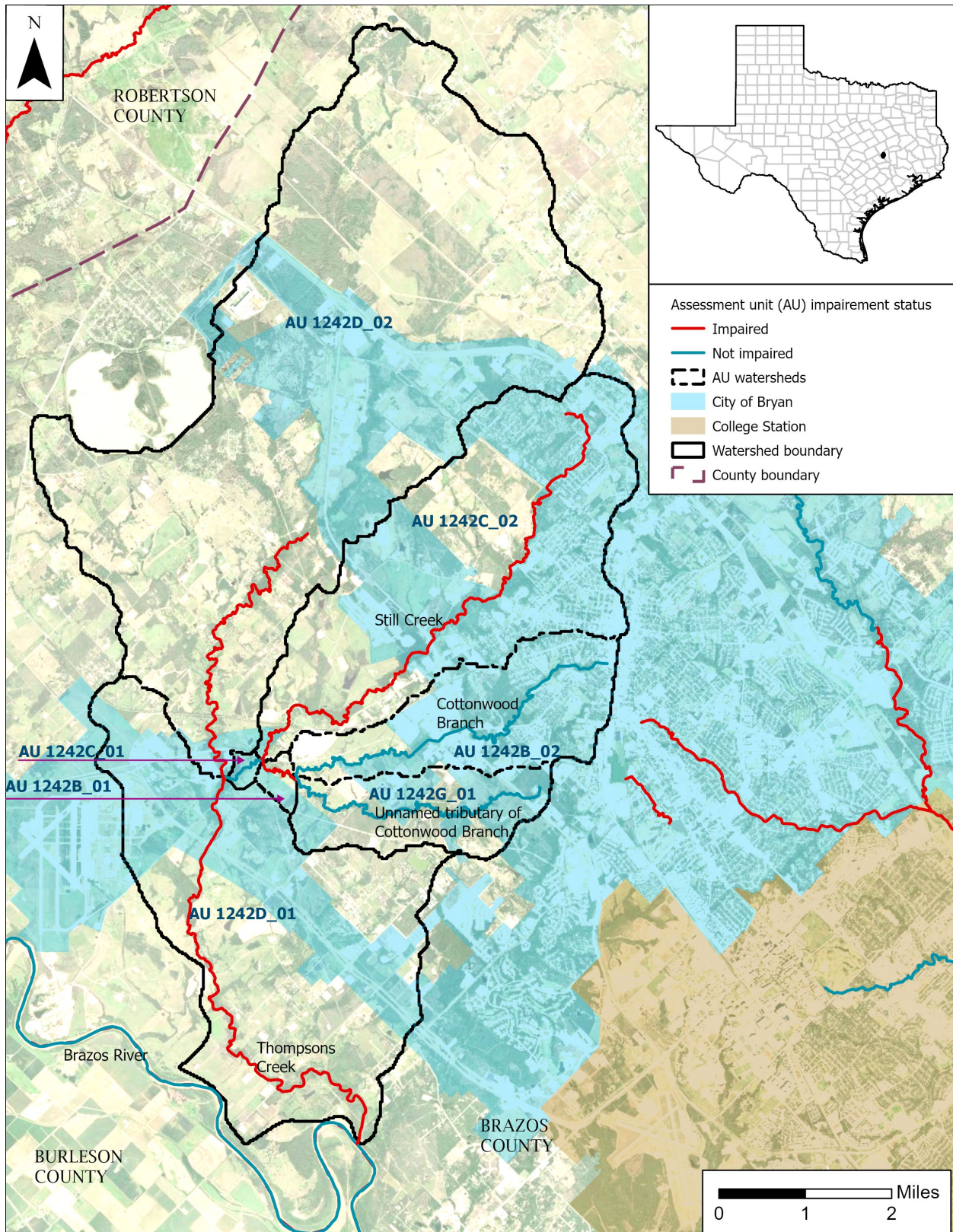


Figure 2-1. Thompsons Creek Watershed boundary and assessment units

2.2 Land Use and Land Cover

The National Land Cover Database (NLCD) provides nationwide data on land cover at a 30 meter (m) resolution. The database provides the ability to understand both current and historical land cover and land cover change. According to the 2021 NLCD land cover data (Dewitz 2023), the dominant land cover in the watershed is pasture/hay which covers almost 53% of the watershed (Figure 2-2). Developed areas make up approximately 23% of the watershed.

Over the past two decades, the watershed has seen significant urban development, particularly in the Cottonwood Branch and Still Creek subwatersheds. According to the 2021 and 2001 NLCD land cover data, developed land has increased by approximately 1360 acres (21%), while forest and pasture lands have decreased by about 11% and 7%, respectively (Dewitz 2023, LaMotte 2016).

2.3 Ecoregions

Ecoregions are land areas with ecosystems that contain similar quality and quantity of natural resources (Griffith et al. 2007). There are four separate delineated levels of ecoregions, with Level I being the broadest classification and Level IV being the most refined (EPA 2023). The Thompsons Creek watershed is within the Level III Ecoregion 33, known as the East Central Texas Plains. Its location within Ecoregion 33 is subdivided into three Level IV Ecoregions 33b, 33c, and 33f, known as the Southern Post Oak Savanna, the San Antonio Prairie, and the Floodplains and Low Terraces, respectively (Figure 2-3). This region has irregular plains that were predominantly covered by post oak savanna vegetation. Soils are variable but tend to be acidic with sands and sandy loams in upland areas and clay to clay loams in low lying areas. Many areas have an underlying clay pan affecting water movement (Griffith et al. 2007).

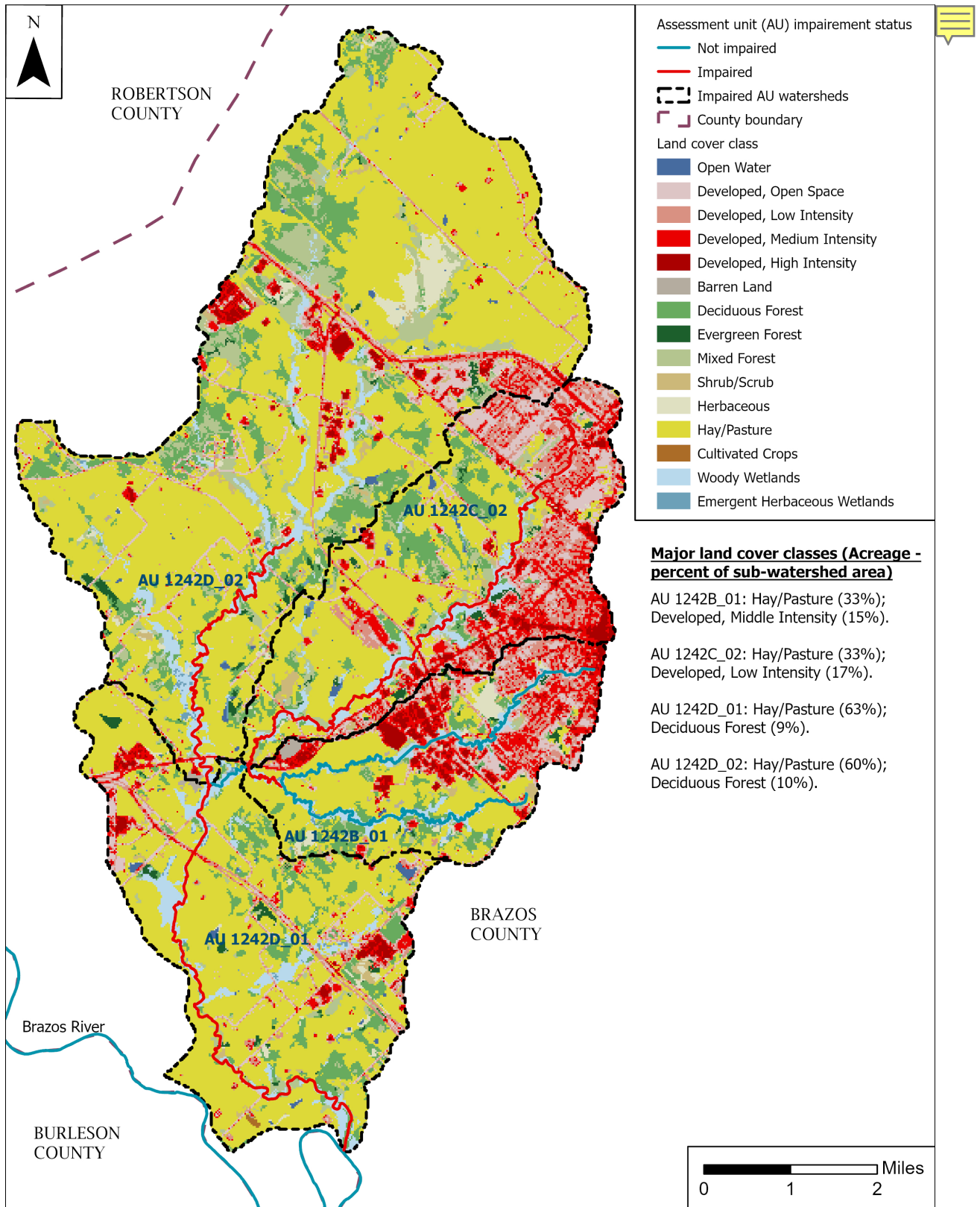


Figure 2-2. Thompsons Creek watershed land cover and land use

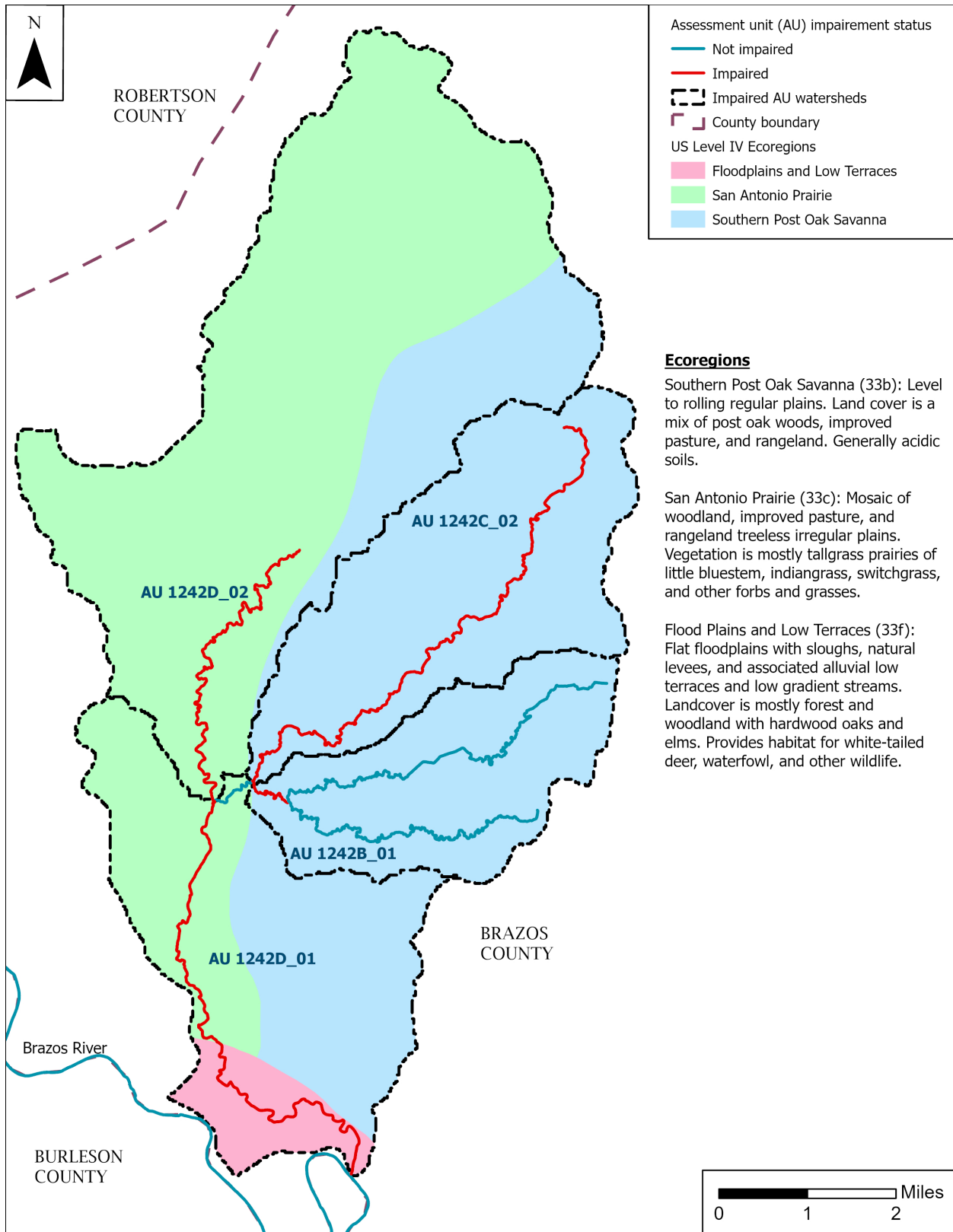


Figure 2-3. Thompsons Creek watershed Level IV ecoregions

2.4 Soils

The United States Department of Agriculture – Natural Resources Conservation Service (NRCS) provides information about soils collected by the National Cooperative Soil Survey, which are available through the Web Soil Survey (Soil Survey Staff 2022). This database describes soil components and properties and provides a hydrologic rating that groups soils by similar runoff properties. These ratings are useful for considering the potential for runoff from properties under consistent rainfall and cover conditions.

Soils in the Thompsons Creek watershed are primarily Group D soils (Figure 2-4). When wet, Group D soils have a higher runoff potential, and water movement is restricted in the soils. Given the high percent coverage of Group D soils in the watershed, runoff generation potential across the watershed is high.

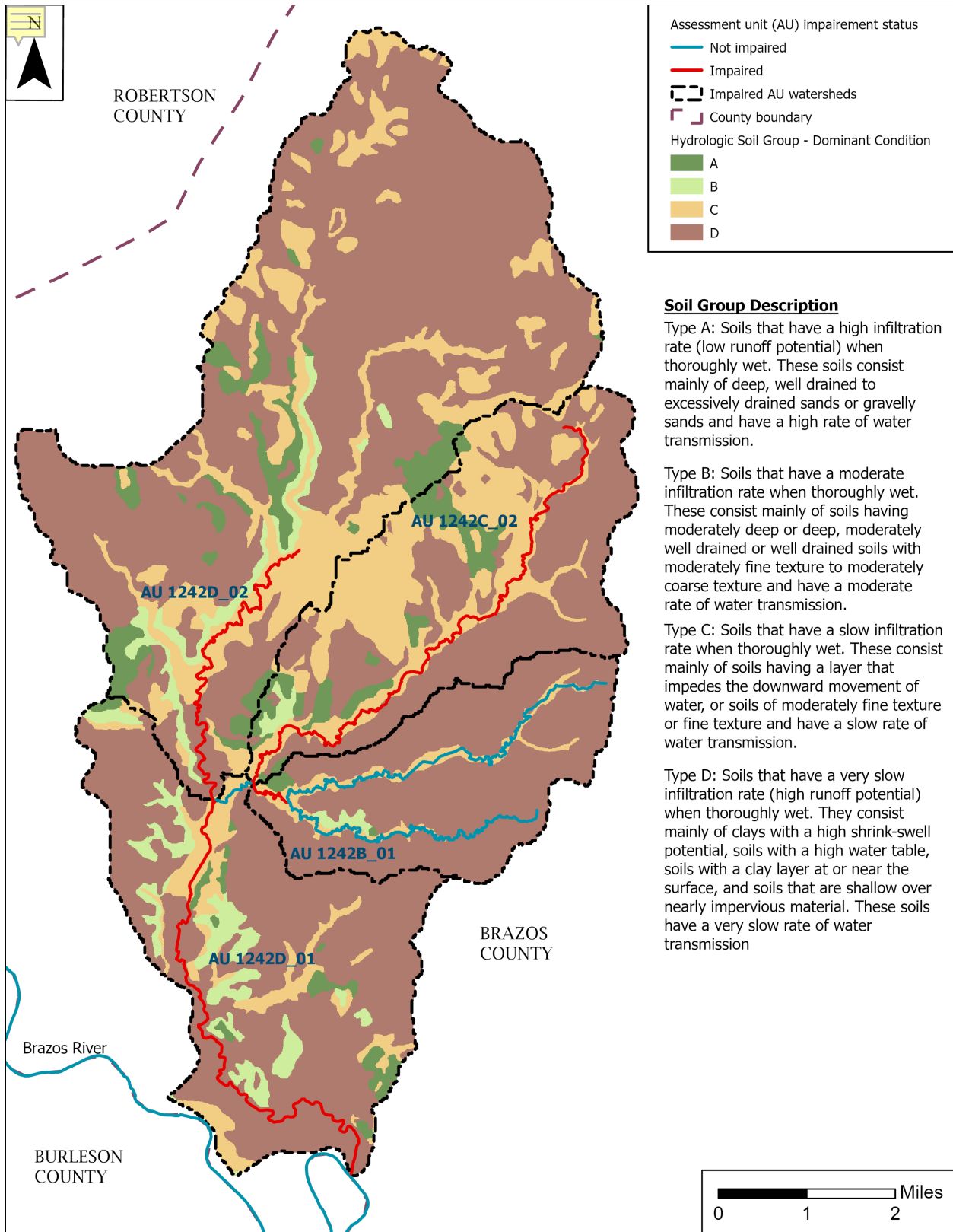


Figure 2-4. Thompsons Creek watershed hydrologic soil group classifications

2.5 Climate

The Thompsons Creek watershed is in the subtropical humid climate region (Larkin and Bomar 1983), which is characterized as a modified marine climate, including warm summers with occasional invasion of drier, cooler continental airflow offsetting the prevailing flow of tropical maritime air from the Gulf of Mexico. Average temperature generally peaks in August (86°F) and average low temperature generally occurs in January (25°F; Figure 2-5). Precipitation data from the College Station Easterwood Field, Texas, weather station (NWS 2023) indicate that the watershed’s mean annual rainfall from 2000–2022 was 40.23 inches. During this period, the lowest annual rainfall values were recorded in 2011 and the highest in 2015 (Figure 2-5). Generally, May is the wettest month (4.73 inches), and July is typically the driest month (2.30 inches).

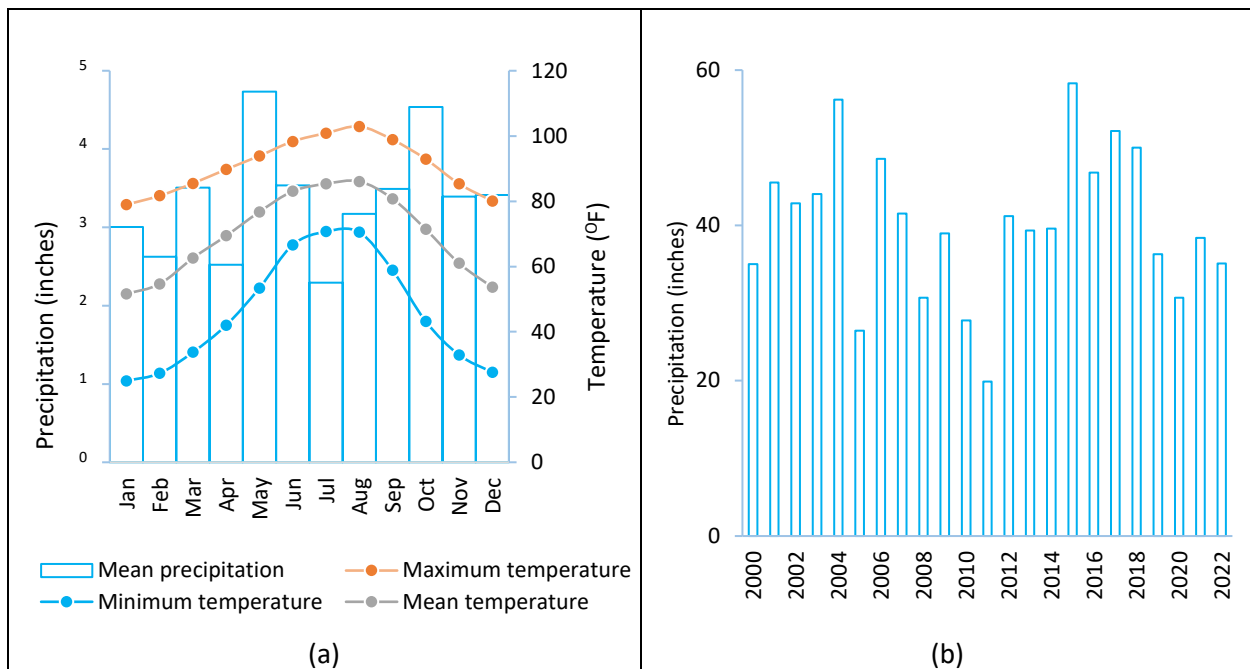


Figure 2-5. (a) Monthly temperature and precipitation and (b) annual precipitation for College Station Easterwood Field, Texas, 2000 - 2022.

2.6 Topography

Watershed hydrology has many key components, including soil properties and topography. Slope and elevation determine the direction of water flow, while slope and soil properties affect the quantity and speed with which water infiltrates into, flows over, or moves through the soil into a water body.

Development and other activities may be limited by soil properties in certain areas.

The United States Geological Survey's (USGS) collection of 10 m resolution Digital Elevation Models (USGS 2023a) provides the highest resolution seamless elevation dataset for the U.S. According to this dataset, elevation across the watershed ranges from a maximum of approximately 128 meters above mean sea level in the northern portion of the watershed to a minimum of about 56 meters above mean sea level where Thompsons Creek flows into the Brazos River (Figure 2-6).

2.7 Aquifers

Texas has numerous aquifers capable of producing groundwater. Statewide, the Texas Water Development Board (TWDB) recognizes nine major aquifers that produce large amounts of water over large areas, and 21 minor aquifers that produce minor amounts of water over large areas or large amounts of water over small areas (Bruun et al. 2016).

The Carrizo-Wilcox aquifer, a major aquifer, underlies the Thompsons Creek watershed and extends from the Louisiana border to the Mexico border in a wide band. The part of the aquifer that underlies the watershed is confined. Groundwater in the confined area of the aquifer is generally softer and has total dissolved solids concentrations less than 1,000 milligrams per liter (Bruun et al. 2016). The minor aquifers that underlie the watershed are the Brazos River Alluvium Aquifer, Queen City Aquifer, and the Sparta Aquifer.

In Texas, local groundwater conservation districts (GCDs) are the state's preferred method of groundwater management. GCDs are charged with managing groundwater by providing for the conservation, preservation, protection, recharging, and prevention of waste of the groundwater resources within their jurisdictions. The watershed is located within the Brazos Valley GCD.

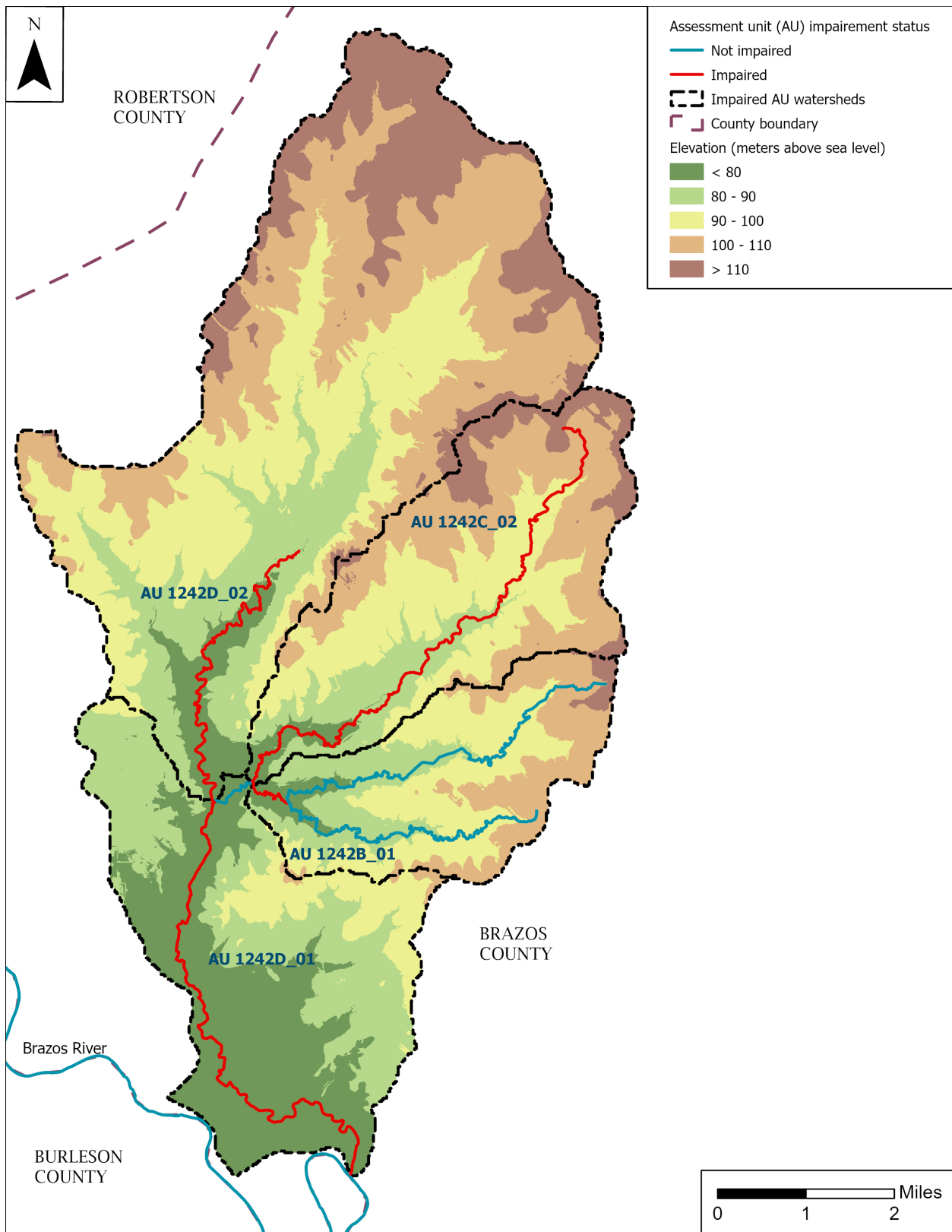


Figure 2-6. Topographical elevation of the Thompsons Creek watershed

2.8 Population

Watershed population estimates were developed using the United States Census Bureau (USCB) 2020 census blocks⁴ data (USCB 2020a) and 2020 decennial population data (USCB 2020b). Based on these data, the population of Thompsons Creek watershed was estimated to be 26,744. Population density is highest in the eastern parts of Cottonwood Branch and Still Creek watersheds in the City of Bryan (Figure 2-7).

TWDB’s regional water plan population and water demand projections (TWDB 2021) provide decadal population projections for counties within Texas from 2020 through 2070. County population growth rates for Brazos County were presumed to be appropriate for estimating population projections for the watershed. The population in Brazos County is projected to grow substantially over the next five decades, more than doubling by 2070 (TWDB 2021). Based on TWDB’s county population projections, the population in the watershed is expected to increase by about 107% by 2070 (Table 2-3).

Table 2-3. The 2020 population and population projections for the Thompsons Creek watershed.

| Assessment unit | 2020 population based on 2020 decennial census data | Population projections based on TWDB’s 2021 Regional Water Plan | | | | |
|-----------------|---|---|--------|--------|--------|--------|
| | | 2030 | 2040 | 2050 | 2060 | 2070 |
| 1242B_01 | 9,234 | 11,154 | 13,524 | 15,837 | 17,130 | 19,134 |
| 1242C_02 | 12,921 | 15,606 | 18,923 | 22,159 | 23,968 | 26,772 |
| 1242D_01 | 1,087 | 1,313 | 1,592 | 1,864 | 2,016 | 2,252 |
| 1242D_02 | 3,501 | 4,229 | 5,128 | 6,005 | 6,495 | 7,255 |
| Total | 26,744 | 32,302 | 39,168 | 45,865 | 49,608 | 55,414 |

⁴ Census blocks are the smallest geographic units used by USCB to tabulate population data.

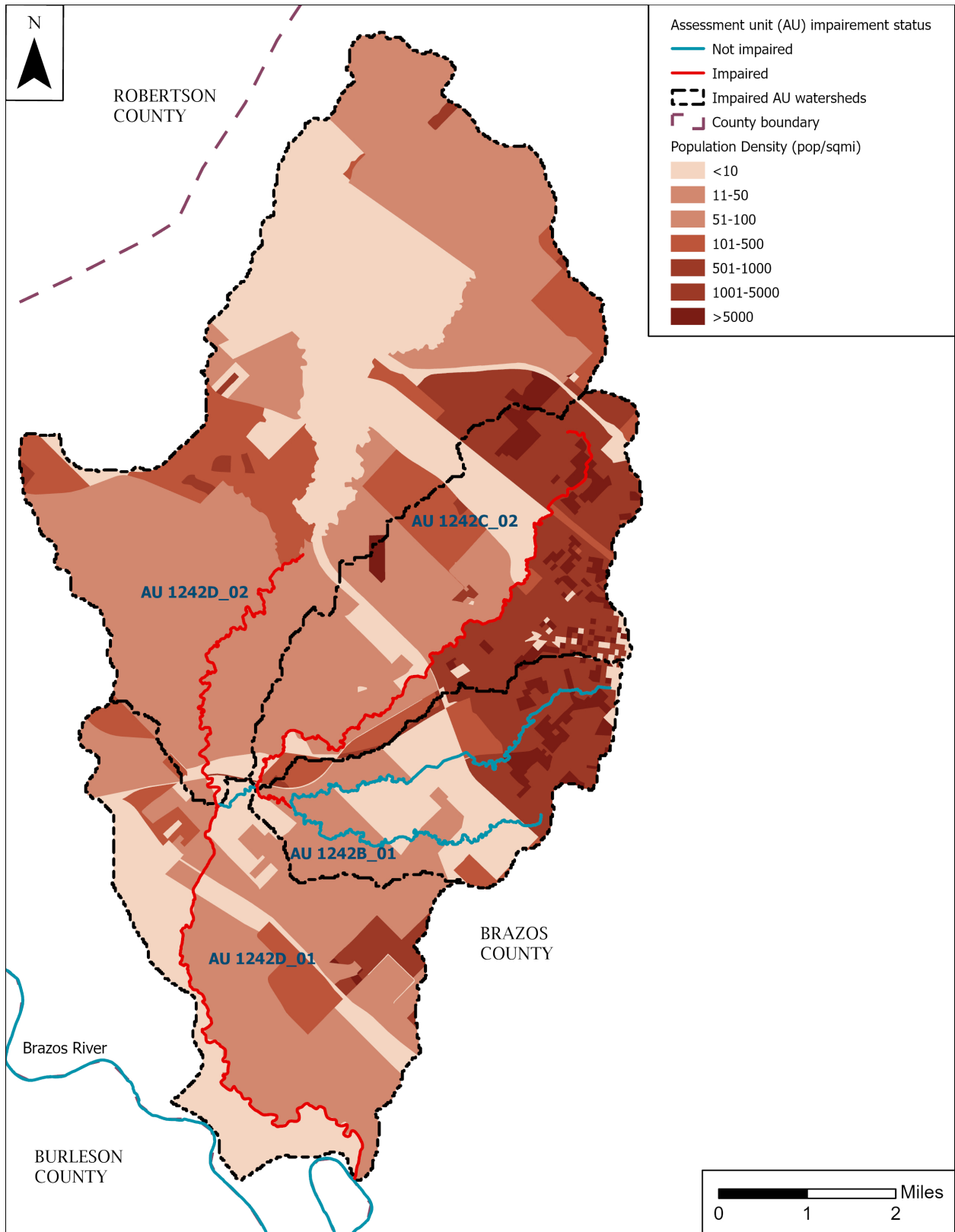


Figure 2-7. Thompsons Creek watershed population density by 2020 U.S. Census Blocks

References

- Bruun, B., Jackson, K., Lake, P., Walker, J. 2016. Texas Aquifers Study: Groundwater Quantity, Quality, Flow, and Contributions to Surface Water. https://www.twdb.texas.gov/groundwater/docs/studies/TexasAquifersStudy_2016.pdf
- Dewitz, J., 2023, National Land Cover Database 2021 Products: U.S. Geological Survey data release. <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
- LaMotte, A., 2016. National Land Cover Database 2001 (NLCD01). <https://doi.org/10.3133/ds383>
- 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 (NWS). 2023. Climate. <https://www.weather.gov/wrh/climate>
- Soil Survey Staff, NRCS. 2022. Web Soil Survey. <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>
- Texas Water Development Board (TWDB). 2021. Regional Water Plan County Population Projections. https://www3.twdb.texas.gov/apps/reports/Projections/2022%20Reports/pop_county
- United States Census Bureau (USCB). 2020a. 2020 TIGER/Line Shapefiles. <https://www.census.gov/geographies/mapping-files.html>
- USCB. 2020b. Decennial Census of Population and Housing Data. <https://data.census.gov/>
- U.S. Environmental Protection Agency (EPA). 2023. Ecoregions of North America. <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. <https://www.sciencebase.gov/catalog/item/4f70aa9fe4b058caae3f8de5>
- USGS 2023b. National Water Information System: Web interface. <https://waterdata.usgs.gov/nwis>