La Nana Bayou Watershed Protection Plan

Chapter 2 – Watershed Characterization

Watershed Description

La Nana Bayou is a 32-mile freshwater stream that extends from the confluence of the Angelina River south of Nacogdoches in Nacogdoches County to the upstream perennial portion of the stream north of Nacogdoches at its confluence with Banita Creek (Figure 1). La Nana Bayou consists of a single segment (0611B) and three assessment units (0611B_01, 0611B_02, and 0611B_03). Routine water quality monitoring began in 1996 and led to the inclusion of La Nana Bayou on the Texas 303(d) List in 2000 as being impaired for elevated bacteria. It remains impaired for not meeting its primary contact recreation standard and has concerns for elevated nitrate-nitrogen and total phosphorous in its downstream reach.

La Nana Bayou is divided into three assessment units (AU) (Figure 1) that the Texas Commission on Environmental Quality uses to incrementally evaluate water quality in the stream. ANRA performs quarterly monitoring through the Clean Rivers Program (CRP) for field and conventional parameters, flow, and *E. coli* at one monitoring station in each AU. This monitoring approach provides good spatial representation of data throughout La Nana Bayou; however, the quarterly monitoring regime limits understanding of temporal variability in flow and pollutant loading.

Land Use and Land Cover

The La Nana Bayou watershed covers approximately 53,269 of deep East Texas that is a mixture of rural and urban land uses (Figure 2). According to the 2019 National Land Cover Database, the dominant land cover in the watershed are forests and they cover almost 37% of the watershed while pastures cover slightly more than 28% of the watershed. Developed areas cover approximately 25% with the City of Nacogdoches predominantly covering the middle portion of the watershed. Other land covers in order of decreasing coverage include wetlands, open water and barren land.

Ecoregions

Ecoregions are land areas with ecosystems that contain similar quality and quantity of natural resources (Griffith, Bryce, Omernik, & Rogers, 2007). There are four separate delineated levels of ecoregions; level I being the most unrefined classification, and level IV is the most refined. The La Nana Bayou watershed is located in the Level III Ecoregion 35, known as the South Central Plains (Figure 3). Where the watershed is located in Ecoregion 35 is subdivided into the Level IV Ecoregions 35a, 35b, and 35e, known as the Tertiary Uplands, Floodplains and Low Terraces, and Southern Tertiary Uplands respectively. The landscape in the area of the Tertiary Uplands is mainly underlain by sand, silt, and gravel. The main land cover are pine-hardwood deciduous forests, with scattered areas of pastures.

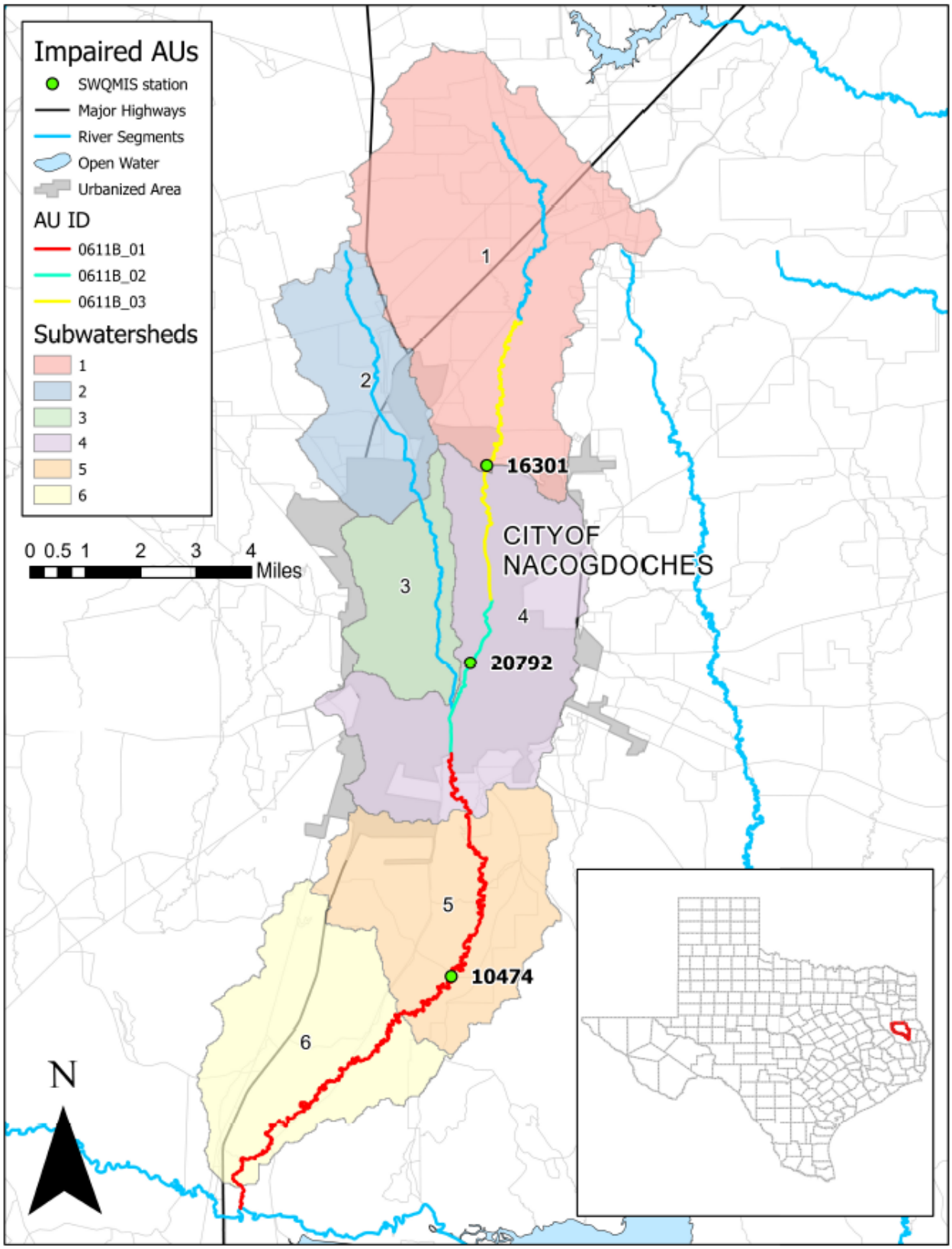

Figure 1. La Nana Bayou watershed boundaries, assessment units and labeled subwatersheds

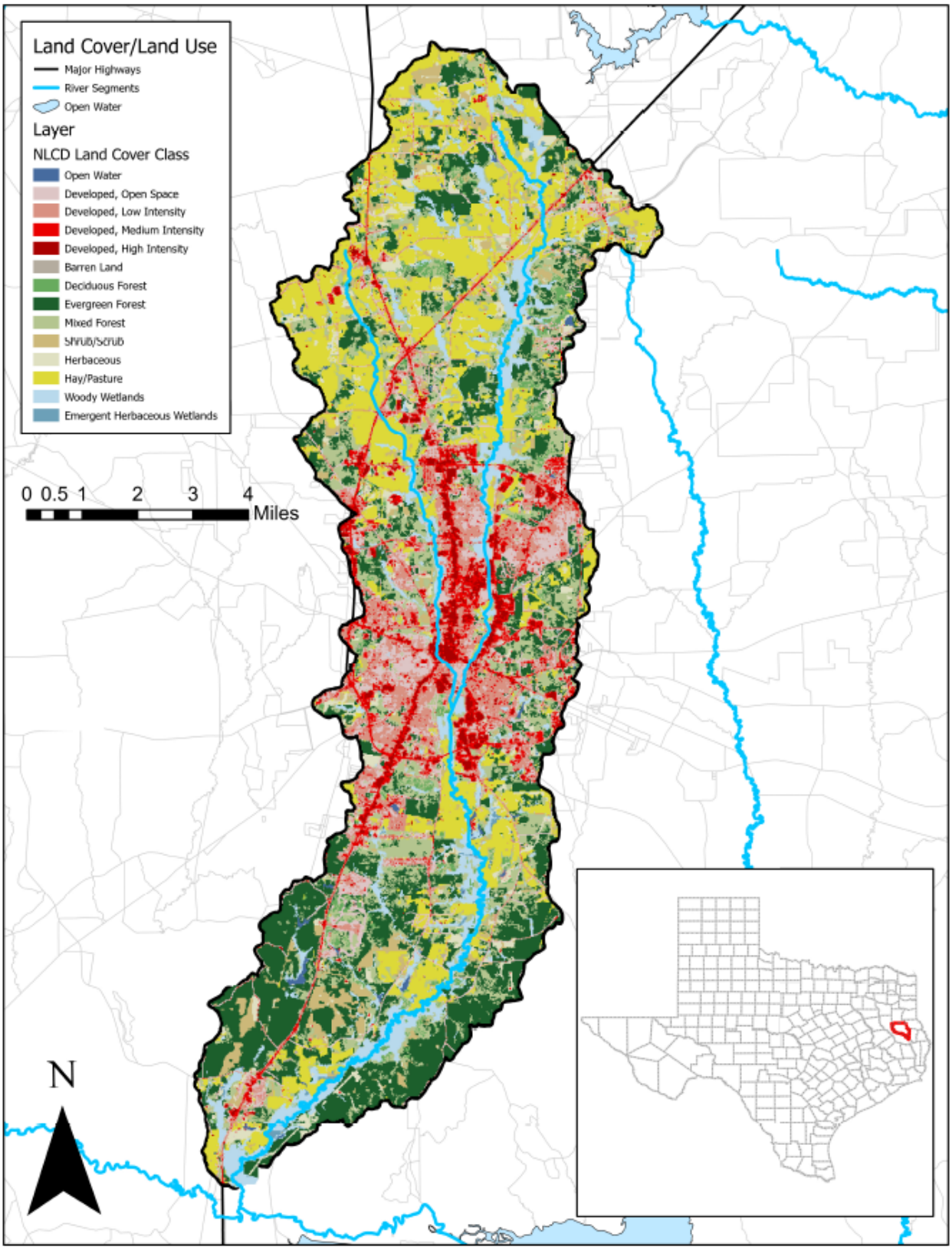

Figure 2. La Nana Bayou watershed land cover and land use

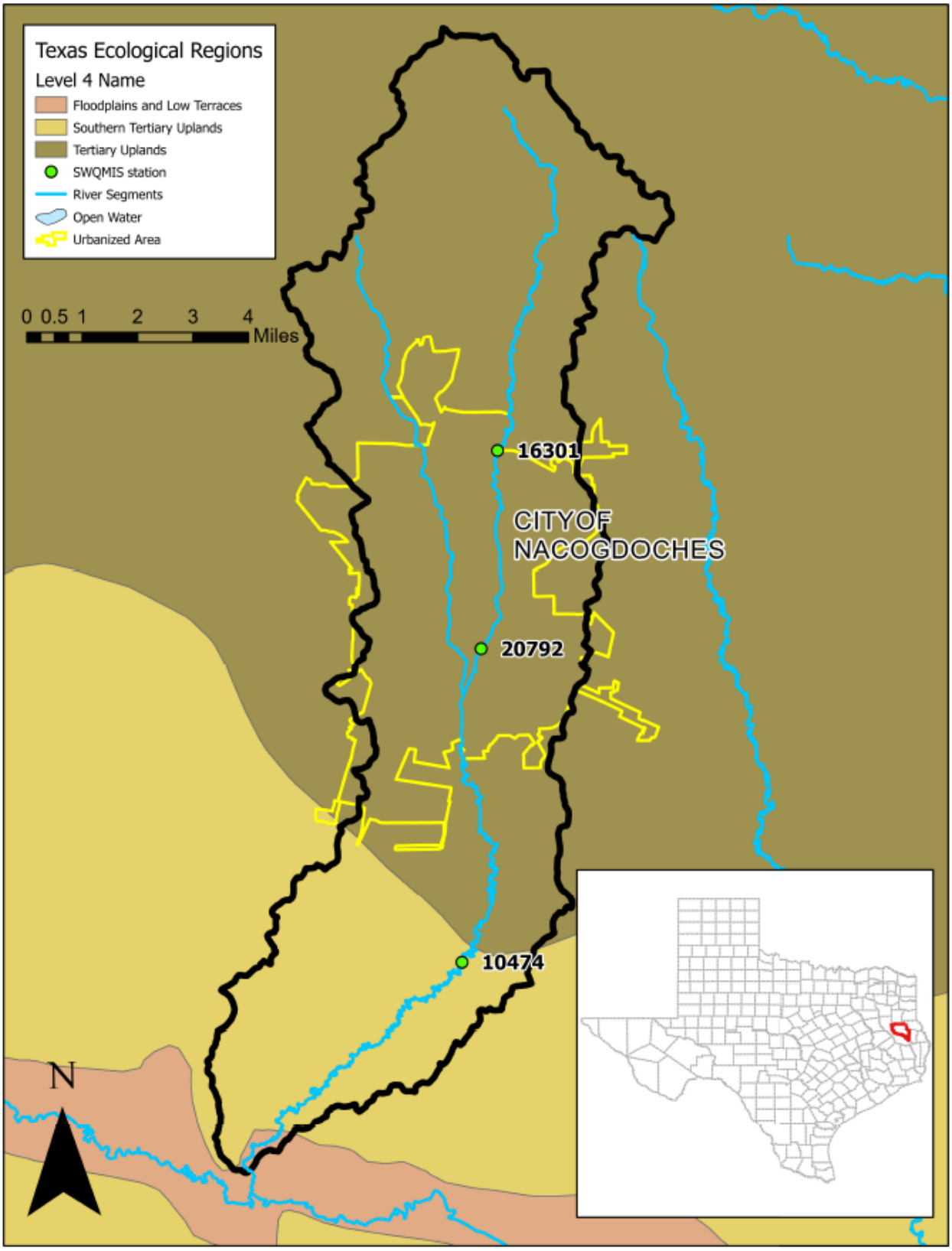

Figure 3. La Nana Bayou level IV ecoregions

Soils

USDA NRCS provides information about soils collected by the National Cooperative Soil Survey, made available through the Soil Survey Geographic Database (SSURGO) database (United States Department of Agriculture Natural Resource Conservation Service, 2018b). This database describes soil components and properties and provides a hydrologic rating which groups soils by similar runoff properties. These ratings are useful for considering the potential for runoff from properties under consistent rainfall and cover conditions. The majority of soils in the watershed are classified as "Type B" and "Type C" soils (Figure 4, Table 1). "Type C" soils, which are indicative of slow infiltration and having high runoff potential when wet, is the majority of soil types in the northern area of the watershed. "Type B" soils, which are indicative of moderate infiltration and having moderate runoff potential when wet, is the majority of soil types found in the central and southern areas of the watershed.

Table 1. Hydrologic soil groups and descriptions

Hydrologic Soil Group	Acres	Description
Null	713	Not rated (not surveyed or water body)
A	6,544	Soils have a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
A/D	212	See below[1]
B	16,162	Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
B/D	320	See below[1]
C	24,698	Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.
C/D	1,873	See below[1]
D	2,747	Soils with a very slow infiltration rate when thoroughly wet. They consist mainly of clays with a high shrink-swell potential, soils with a high water table, soils with a clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

[1]USDA NRCS, 2018a: "Certain wet soils are placed in Group D based solely on the presence of the water table within 24 inches of the surface, even though saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on saturated hydraulic conductivity and water table depth when drained. The first letter applies to the drained condition and the second to the undrained condition. For purposes of hydrologic soil group, adequately drained means that seasonal high water tables are at least 24 inches below the surface in a soil where it would be higher in a natural state."

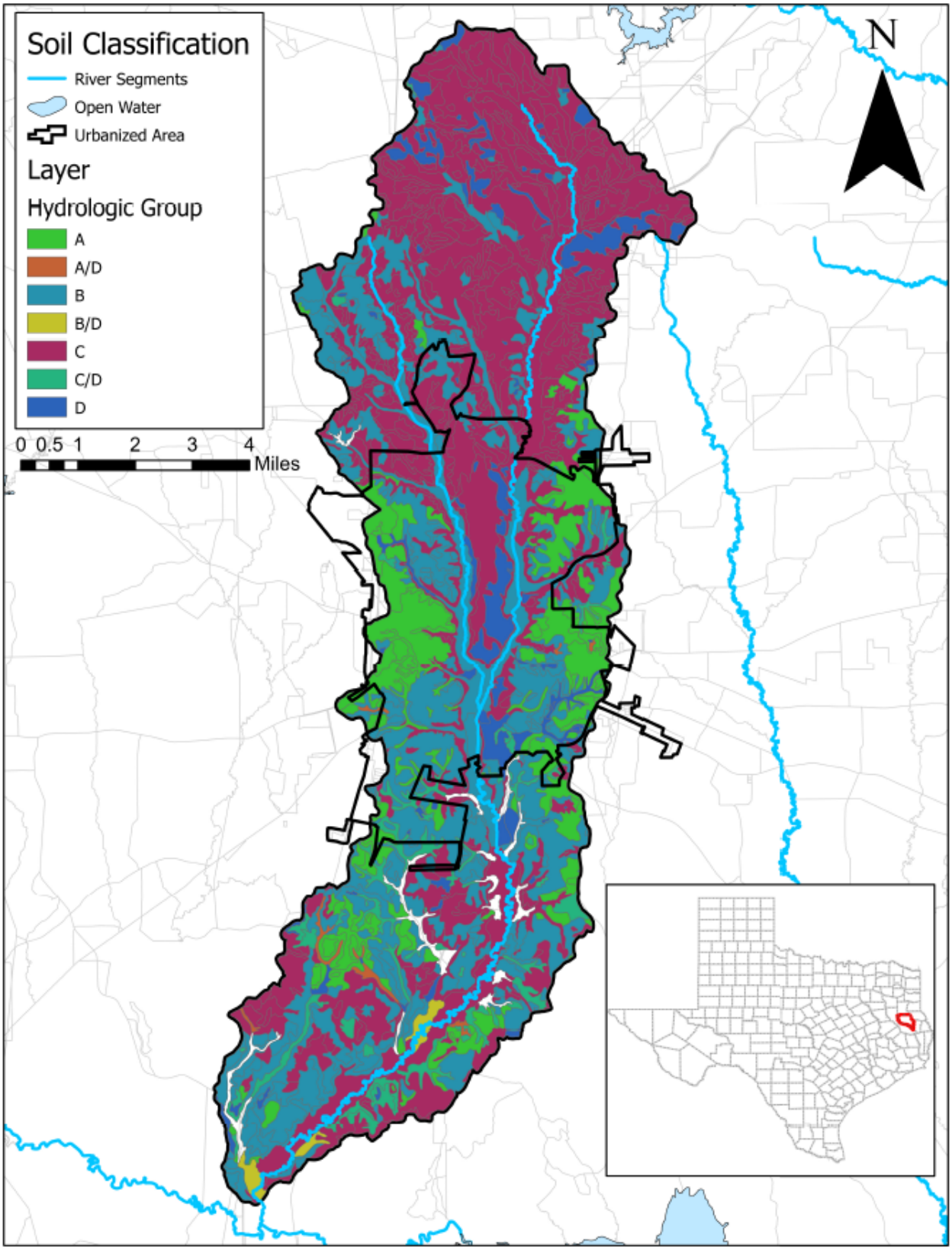

Figure 4. La Nana Bayou hydrologic soil group classifications

Climate and Rainfall

The watershed subtropical humid climate region (Larkin & Bomar 1983). This region's climate is characterized as a modified marine climate including warm summers with the occasional invasion of drier, cooler continental airflow offsetting the prevailing flow of tropical maritime air from the Gulf of Mexico. Precipitation data from the Nacogdoches, TX weather station indicates that the watershed's mean annual rainfall from 1991-2020 was 49.94 inches. Average temperatures generally peak in August (93.3°F) and average low temperature generally in January (36.4°F)(Figure 5) (National Oceanic and Atmospheric Administration, 2021). December (4.78 inches) is noted as the wettest month, while July (2.88 inches) is typically the driest month. Average annual precipitation values across the study area from the PRISM Climate Group at Oregon State (PRISM Climate Group, 2016) indicate average annual rainfall ranges from 50 to 51 inches per year across the watershed (Figure 6).

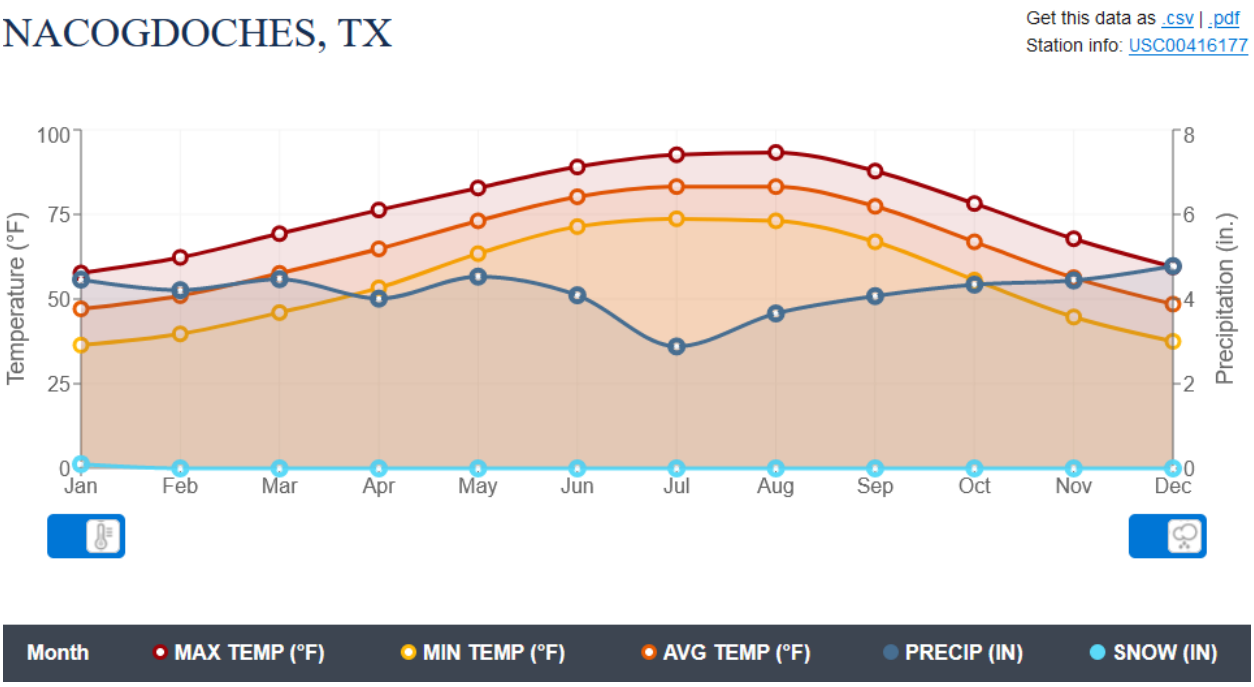

Figure 5. Nacogdoches TX climate normals from 1991-2020

Topography

Watershed hydrology has many key components, including soil properties and topography. Slope and elevation determine the direction of water flow while elevation and soil properties effect the quantity and speed which water will infiltrate into, flow over, or move through the soil into a water body. Development and other activities may be limited by soil properties in certain areas. The elevation across the watershed ranges from approximately 614 ft above mean sea level (MSL) maximum elevation in the northwestern portion of the watershed to a minimum elevation of about 175 where La Nana Bayou flows into the Angelina River (Figure 7).

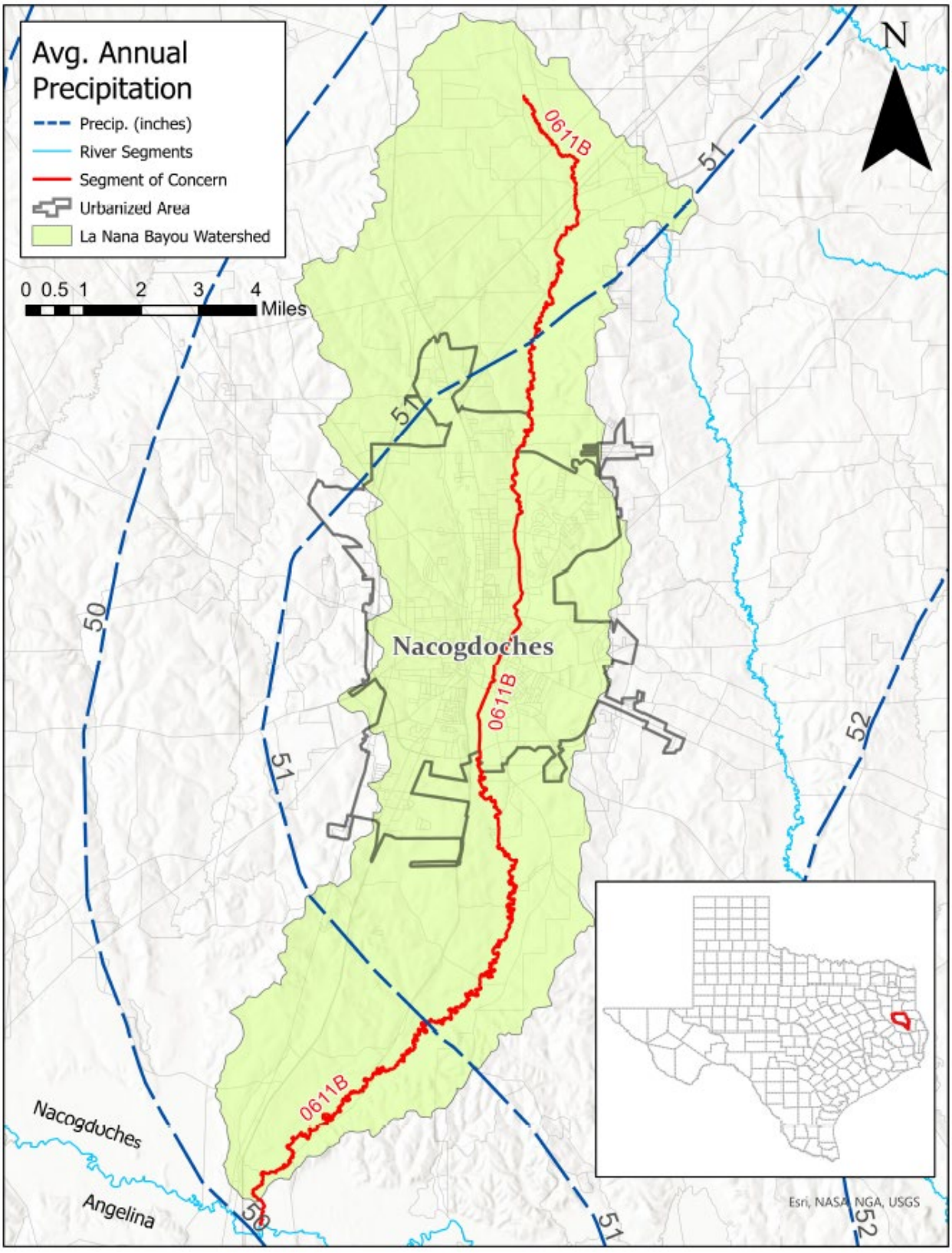

Figure 6. Normal average annual precipitation totals across the watershed

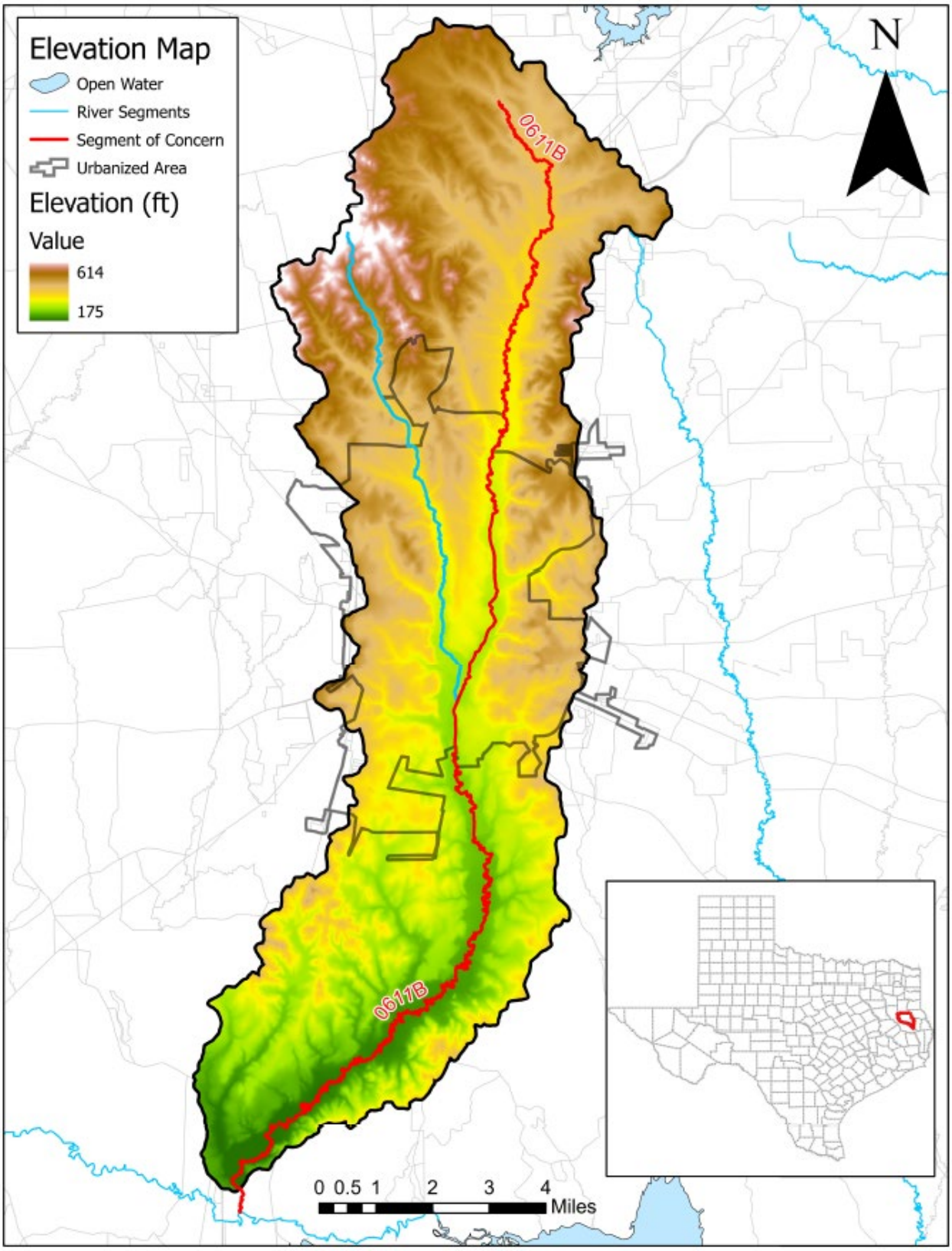

Figure 7. Topographical elevation of the La Nana Bayou watershed

Population

According to the 2010 Census data, watershed population is estimated to be 36,710. The highest population densities and the bulk of population in the watershed are in the Nacogdoches city limits (Figure 8). The communities of Appleby and Redfield also have a higher concentration of homes and people compared to much of the watershed. Small clusters of homes also exist throughout the watershed and normally occur along main roadways including highways 59 and 259, Farm-to-Market roads and some county roads. Population in Nacogdoches County is expected to increase greatly over the next 50 years with a 65% increase projected in the 2021 Regional Water Plan (TWDB, 2021).

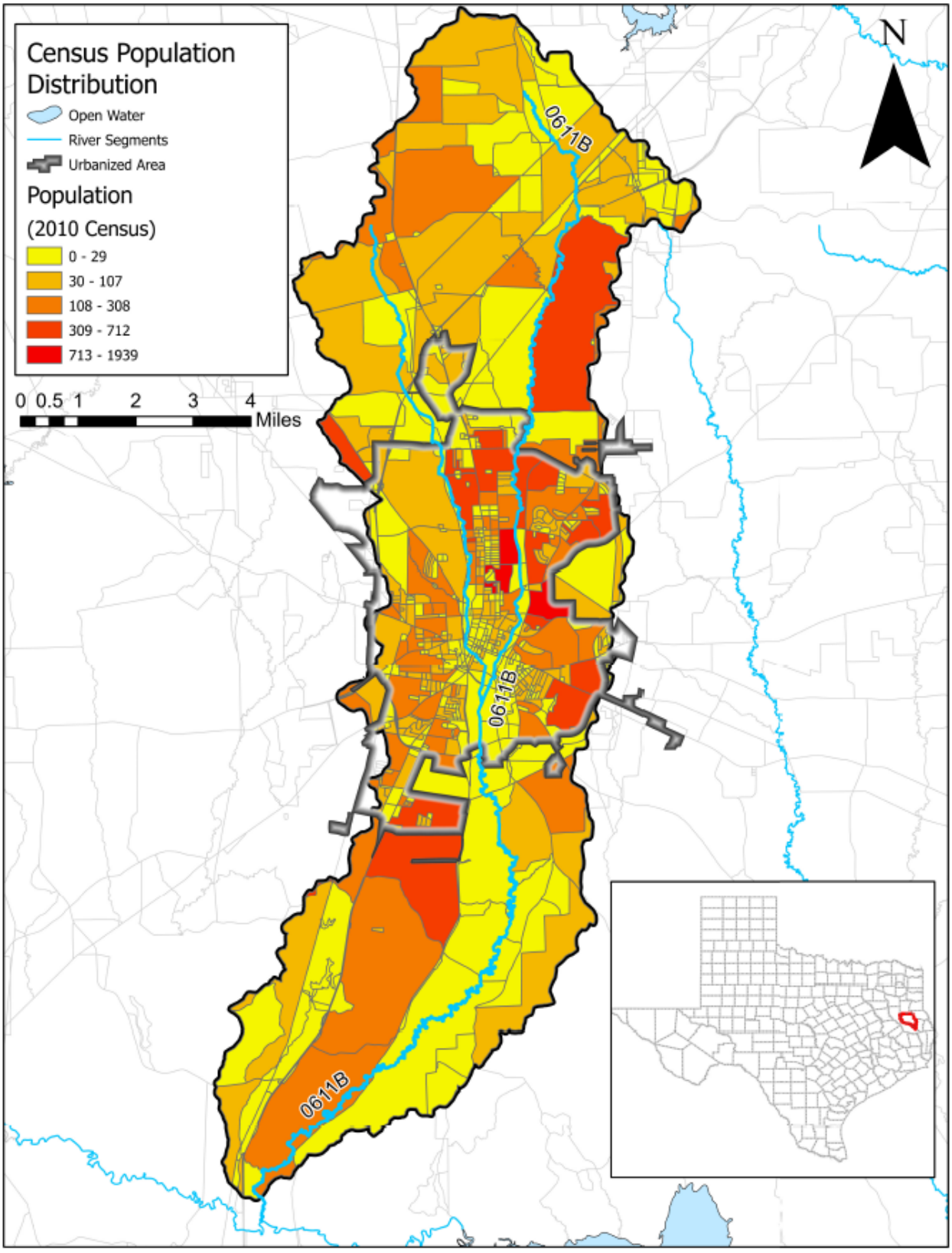

Figure 8. Watershed population density by 2010 US Census Blocks

References

NOAA 2021. U.S. Climate Normals 1991-2020. Accessed October 18, 2021 online at: https://www.ncei.noaa.gov/access/us-climate-normals/#dataset=normals-monthly&timeframe=30&location=TX&station=USC00416177

TWDB 2021. Regional Water Plan County Population Projections. Accessed October 18, 2021 online at: https://www3.twdb.texas.gov/apps/reports/Projections/2022%20Reports/pop_county